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MINERAL LAND CLASSIFICATION OF THE GREATER LOS ANGELES AREA

1987

CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY

SPECIAL REPORT 143
Part VI

Classification of
Sand and Gravel Resource Areas

CLAREMONT-UPLAND
PRODUCTION-CONSUMPTION REGION

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SPECIAL REPORT 143
MINERAL LAND CLASSIFICATION
OF THE GREATER LOS ANGELES AREA

Part VI

Classification of Sand and Gravel Resource Areas, Claremont-Upland Production-Consumption Region

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1987

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PREFACE

The Los Angeles metropolitan area, with a population of nearly 10 million people, is the largest urbanized area in California. This region includes the southern part of Los Angeles County and parts of San Bernardino, Riverside, and Orange counties. Although substantial parts of the Los Angeles area have been developed, widespread urbanization is still occurring at a rapid rate.

In any metropolitan or rural region undergoing urban development, it is of considerable importance that adequate supplies of mineral commodities be readily available. Minerals used in construction, particularly aggregate used in concrete, should be available from the region in sufficient quantities to assure reasonable costs. For many years, the Los Angeles area has been fortunate in this respect: adequate quantities of low-cost aggregate materials, chiefly sand and gravel, have been available locally. However, as more and more land in the region becomes urbanized, nearby sand and gravel deposits suitable as sources of low-cost aggregate are being depleted by mining or lost to competing land uses.

The principal objective of this project is to classify land in the Los Angeles area into Mineral Resource Zones based on guidelines adopted by the State Mining and Geology Board. This classification will assist the Board in the event the Board contemplates designation of lands containing regionally significant aggregate resources pursuant to the Surface Mining and Reclamation Act of 1975.

Information on the classification of land for construction aggregate, within the Los Angeles Metropolitan area, is presented in Division of Mines and Geology Special Report 143. There are seven parts to this report. The first is an introductory section describing the background, purpose, and scope of the project. The six remaining sections discuss the classification of seven production-consumption regions and include maps showing the locations of significant sand and gravel deposits and an explanatory text with tables and charts that present data on population, production, aggregate consumption, future requirements and estimates of aggregate resources.

Part I, the introductory section, and Part II of Special Report 143, which explains the classification of sand and gravel resource areas in the San Fernando Valley Production-Consumption Region, were published in a single volume. Part I is also being published as a separate volume. The present volume, which focuses on the classification of sand and gravel resource areas in the Claremont-Upland Production-Consumption Region, is Part VI of Special Report 143.

The reader may wish to refer to "Aggregates in the Greater Los Angeles Area," Division of Mines and Geology Special Report 139, which describes and evaluates the significance, uses, prices, marketing, transportation, supply, and other factors that relate to the aggregate industry of the greater Los Angeles metropolitan area.

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EXECUTIVE SUMMARY

Based upon the projected population increase and the predicted per capita consumption rates, approximately 245 million tons of aggregate will be required to satisfy demand in the Claremont-Upland Production-Consumption Region through the year 2031.

Current reserves (aggregate material believed to be acceptable for commercial use that exist within property owned or leased by an aggregate producing company and for which permission allowing extraction and processing has been granted by the proper authorities) total approximately 55 million tons, which is less than one-fourth (10-year supply) of the requirements needed for the 50-year period.

Non-permitted resources (potentially usable aggregate materials that may be mined in the future but for which no use-permit allowing extraction has been granted, or for which development has not been definitely established to be feasible based upon current technology or economic conditions) within the Claremont-Upland Production-Consumption Region total more than one and one-third billion tons. Half of this lies within two alluvial fans (San Antonio and Cucamonga) with current aggregate operations. The remainder lies within open land on Deer and Day fans and within San Dimas Wash which have no current or historic aggregate production. Urbanization pressure is high in all of these areas.

None of the three regions adjacent to Claremont-Upland contain enough aggregate reserves for the next 50 years. Claremont-Upland may experience a shortage first and need to import from these surrounding regions.

The following conclusions were reached:

1. The area possesses sufficient resources to supply the needed aggregate well beyond the 50-year period if future land-use patterns do not preclude the extraction of those resources.

2. In order to have an assured supply of aggregate beyond the next 10 years, consideration should be given to the dedication of available resource land to temporary land uses in anticipation of its eventual use as an aggregate source.

3. Should the adjacent San Gabriel Valley and Orange County-Temescal Valley P-C regions experience the aggregate short falls that are projected for them, the resources in the Claremont-Upland P-C Region could help fill their aggregate demands if coordination could be attained between the jurisdictions. We recognize that such coordination is not simple to arrange or ensure.

CLASSIFICATION OF SAND AND GRAVEL RESOURCE AREAS, CLAREMONT-UPLAND PRODUCTION-CONSUMPTION REGION

INTRODUCTION

Land in the Claremont-Upland Production-Consumption (P-C) Region of the greater Los Angeles metropolitan area (see SR 143, Part I, Plate 1.2) has been classified by the California Department of Conservation's Division of Mines and Geology (DMG) according to the presence or absence of significant sand and gravel deposits (suitable for use in construction grade aggregate). The land classification is presented in the form of maps showing Mineral Resource Zones (MRZs) as described in Part I of SR 143. Eleven such maps on the U.S. Geological Survey topographic quadrangle bases accompany this report (Plates 6.2-6.12). Refer to Figure 6.1 for a location map of the P-C Region and Figure 6.2 for an index to quadrangle maps covering the Claremont-Upland P-C Region. A list of lead agencies located within the Claremont-Upland P-C Region is presented on Table 6.1.

ESTABLISHMENT OF THE P-C REGION AND MINERAL RESOURCE ZONES

The boundaries of the Claremont-Upland P-C Region circumscribe the primary marketing region for sand and gravel produced from the San Antonio and Cucamonga alluvial fans. These fans constitute one of seven sand and gravel production districts in the greater Los Angeles metropolitan area (see SR 143, Part I, pages 5 and 7 and Figures 1.2 and 1.3).

The P-C region boundaries were established based on the marketing area served by these fans. Mineral Resource Zones (as defined by the "Guidelines for Classification and Designation of Mineral Lands," SR 143, Part I, Appendix A-3, p. 7) within the Claremont-Upland P-C Region were delineated on the basis of a sand and gravel resource appraisal which included study of pertinent geologic reports and maps, field investigations, analysis of drill-hole data collected from the past 70 years and inspections of aerial photographs.

Areas Classified MRZ-1

Plate 6.1 shows the general localities of the Claremont-Upland P-C Region which are classified as MRZ-1. These are areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence (see "Guidelines for Classification and Designation of Mineral Lands," Appendix A-3 in SR 143, Part I, p. 32).

Many areas classified MRZ-1 are located in hilly or mountainous terrain. Classification of these areas was made mainly on the basis of available geologic mapping and field investigation. These areas include parts of the San Jose and Puente hills and small areas in the San Gabriel Mountains. Rocks unsuitable for use as aggregate include: shale, siltstone, and carbonates of the Puente Formation; mappable units of chlorite schist in the San Gabriel Mountains; and highly silicified and pyritized portions of the Glendora Volcanics.

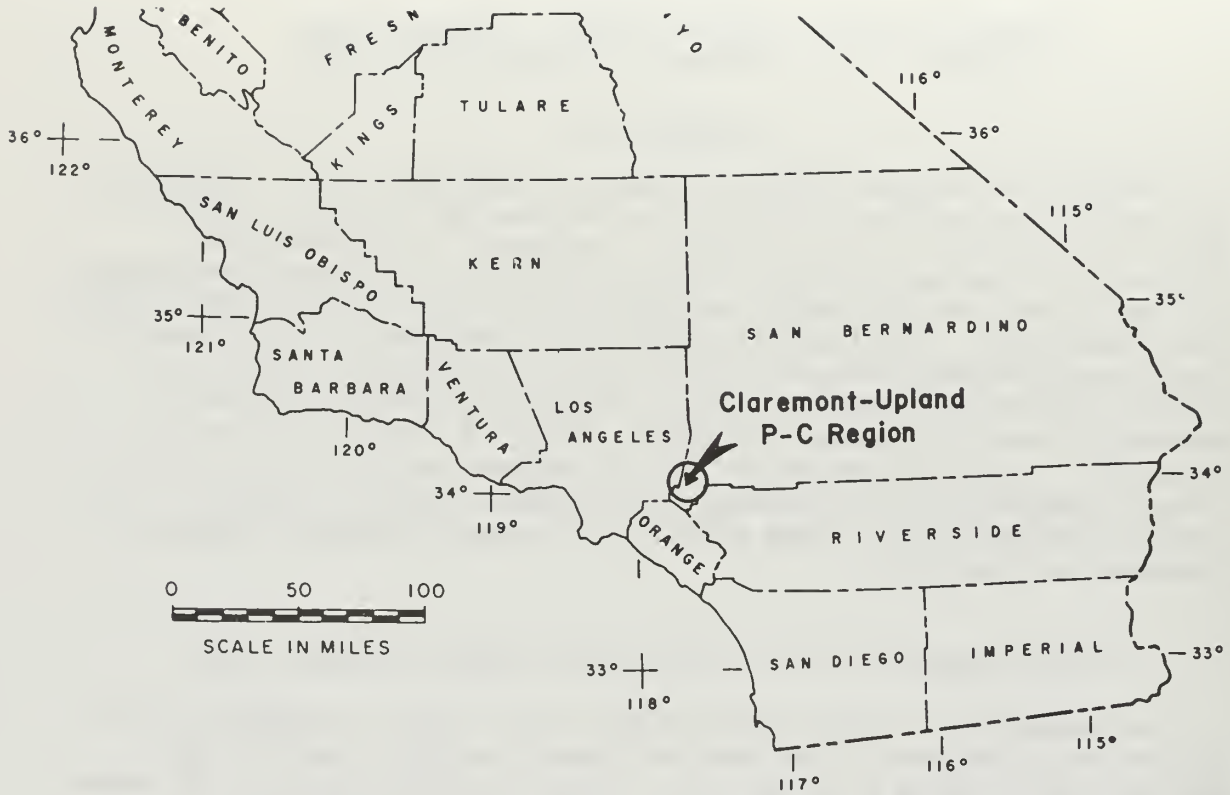

Figure 6.1 Location map of Claremont-Upland P-C Region.

LOS ANGELES COUNTY

Claremont	▲ San Dimas
Industry	Walnut
▲ La Verne	West Covina
▲ Pomona	

SAN BERNARDINO COUNTY

Chino	▲ Rancho Cucamonga
▲ Montclair	▲*Upland
▲ Ontario	

Table 6.1 List of lead agencies (county and incorporated cities) located within the Claremont-Upland P-C Region. Cities that have active aggregate operations within their jurisdictional boundaries are denoted by asterisks. Cities that have land within their jurisdiction classified MRZ-2 are denoted by ▲ .

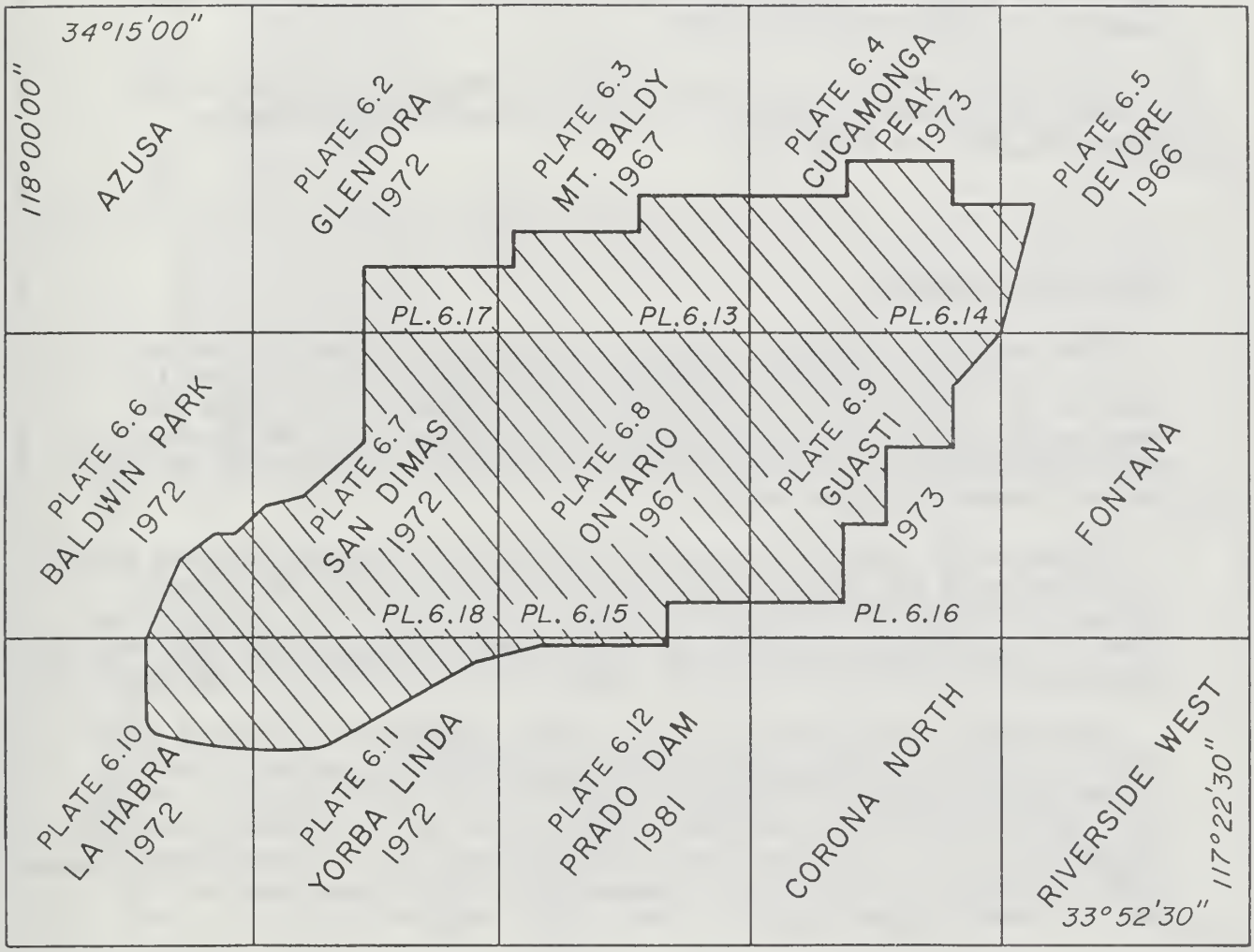

Figure 6.2 Index map of U.S. Geological Survey 7.5-minute quadrangles covering the Claremont - Upland P-C Region(hachured) and vicinity. Upright plate number above the quad name indicates the corresponding Mineral Resource Zone Map; italicized plate number along bottom of quad outline indicates the corresponding Resource Sector Map.

Several MRZ-1 areas also occur within the alluvial terrains of the P-C region. Well-log data indicate the predominance, within these areas, of fine-grained sedimentary deposits unsuitable for use as aggregate.

Areas Classified MRZ-2

Plates 6.1 and 6.20 show the general localities within the Claremont-Upland P-C Region which are classified MRZ-2. These are areas where adequate information indicates that significant mineral deposits are present or there is a high likelihood for their presence ("Guidelines for Classification and Designation of Mineral Lands," Appendix A-3 in SR 143, Part I, p. 32). In addition, the geologic factors that resulted in the formation of the deposit must be understood clearly enough that reasonable interpretations can be made from surface exposure of the material and from drill-hole data.

Deposits within the Claremont-Upland P-C Region satisfying these criteria occur within several alluvial fan deposits, San Antonio Reservoir, and San Dimas Wash.

Alluvial Fan Deposits

Four coalescing alluvial fans in and near the cities of Claremont, Upland, and Rancho Cucamonga comprise a significant sand and gravel resource for this region. From west to east these alluvial fans are known as San Antonio, Cucamonga, Deer, and Day fans. The sedimentary materials forming these fans were derived from rocks exposed in the San Gabriel Mountains to the north.

Alluvial fan deposits are formed when mountain streams carrying large volumes of sand and gravel enter into a valley or plain. The abrupt decrease in slope and confinement causes a decrease in the transporting energy of the stream, resulting in deposition of coarse gravel near the apex of the fan and finer material toward the distal parts of the fan.

San Antonio and Cucamonga alluvial fans: Aggregate production from these two fans is taking place in the City of Upland, located 34 miles northeast of downtown Los Angeles (Figure 1.2, of SR 143, Part I; Plate 4.1). A total of five operations are active in this production district (Figure 6.3) and include the Blue Diamond-Upland plant, Conrock-Upland plant, Holliday Rock-Upland and -Campus (Tri-City) plants, and Pacific Rock and Gravel-Upland plant.* These plants have rated capacities of

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*Just prior to publication of this report the Division of Mines and Geology received notification that Pacific Rock and Gravel is no longer producing aggregate from their Upland plant. Production ceased in December, 1983 after all permitted resources (reserves) were mined from this site. The resource and reserve tonnages presented in Table 6.2 are accurate as of January 1984 - the time of calculation.

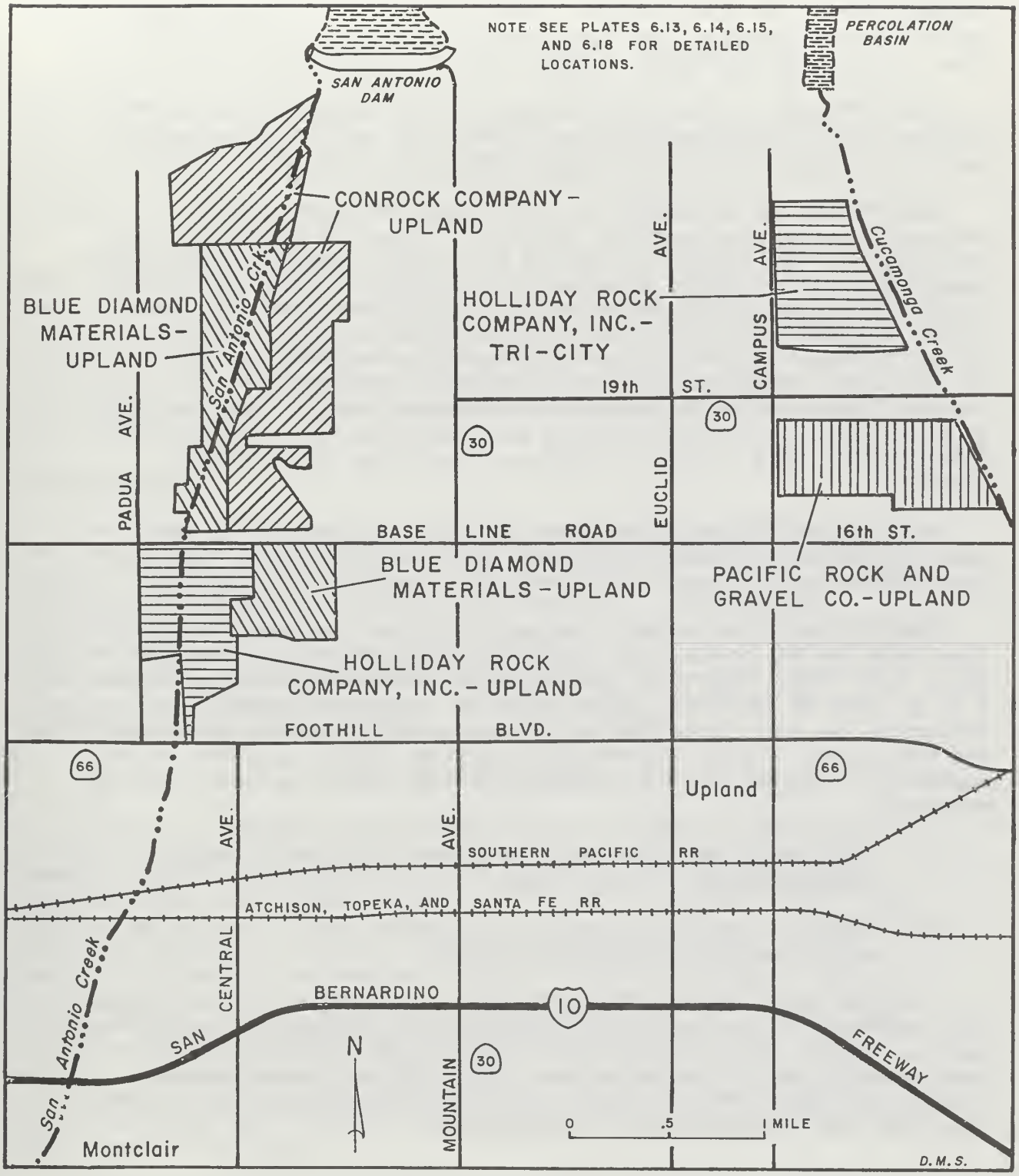

Figure 6.3 Sketch map of San Antonio and Cucamonga fan district showing land owned or leased by aggregate companies as of January, 1982.

between 250 and 550 tons per hour. Annual production for the 11-year period from 1970 through 1980 ranged from 2 million to 4 million short tons of processed aggregate.

The following information on San Antonio and Cucamonga fans has been derived from the aggregate companies, water-well and bridge-foundation-boring logs, field observations, and published geologic maps.

San Antonio and Cucamonga fans are composed of poorly sorted sediments ranging from oversized boulders to clay-size particles. The coarse material is composed of several rock types, the most common being quartz diorite, high grade metamorphic rocks, granodiorite, and schist. Except for exposures of older alluvium, upper layers of the fans contain clasts that are hard and durable. The surface outcrop material was delineated based on published geologic maps (Cox and Morton, 1978; Morton, 1974), field observations and geomorphic analysis of pre-development aerial photographs and topographic maps. Depth to the older alluvium varies both laterally and longitudinally across the fan (plate 6.20). This is due to a complex depositional and erosional history.

Deer and Day alluvial fans: Less is known about these fans than about the two western fans. Water-well and foundation-boring logs are less numerous and no commercial extraction of aggregate has occurred.

However, available evidence and geologic reasoning indicates a high likelihood for the presence of significant aggregate deposits within these fans. Those logs which are available describe sand and gravel from 0 to at least 30 feet below ground surface. The ground surface throughout the area classified MRZ-2 is very cobbly, fairly undissected and tan to gray in color (rather than red which indicates oxidation and weathering). Durable sand and gravel with less than 20 percent fines was observed:

1) from the surface to a depth of 25 feet in the walls of an inactive borrow pit on Day fan.

2) from the surface to a depth of 15 feet in stream cuts and man made trenches traversing both fans.

Portland cement concrete aggregate was produced from a plant located just southeast of the Claremont-Upland Region, on the distal, coalescing portion of Deer, Day, and Lytle fans. Furthermore, Deer and Day fans were developed under similar geologic conditions, and the sediments forming them eroded from the same type of source rock units that provided clasts for the San Antonio and Cucamonga fans.

San Antonio Reservoir

The San Antonio Reservoir is a flood control dam and basin constructed at the mouth of San Antonio Canyon, at the foot of the San Gabriel Mountains. San Antonio Creek currently drains a large portion of the mountains north of Upland and Claremont. During periods of heavy rainfall, sediment and debris is transported along the canyon and impounded behind the dam. Consequently, material must periodically be removed from the reservoir area to preserve the effectiveness of the dam.

Removal of this material for use as concrete aggregate began in 1976 and is continued currently by two operators, L and M Construction Company and Intravaia Rock and Sand Company. The companies operate under a lease issued by the U. S. Corps of Engineers. Sand to gravel ratios range from 75/25 to 35/65, but average at around 50/50 (based upon volume). Common clast types are presumed to be those present within the drainage basin of San Antonio Creek, i.e., quartz diorite, high-grade metamorphic rocks, and schists.

San Dimas Wash

San Dimas Wash issues into a fairly large reentrant in the southern face of the San Gabriel Mountains and, extending southeastward, incises older alluvial deposits (1954 and 1953 editions of U.S. Geological Survey 7 1/2-minute San Dimas and Glendora quadrangles). Coarse, clean aggregate material was observed on the surface in this sector; also, well logs record gravel to depths of 30 to 70 feet. There are no indications that aggregate was ever produced from this deposit; however, material from San Dimas Wash is carried to and mixes with alluvium in the San Gabriel fan to the west, which is mined for aggregate.

Areas Classified MRZ-3

Plate 6.1 shows the general localities of the MRZ-3 areas within the Claremont-Upland P-C Region. These areas incorporate land containing mineral deposits, the significance of which cannot be evaluated from available data (see Appendix A-3 in SR 143, Part I, p. 32). MRZ-3 areas located in valley or basin regions of the Claremont-Upland P-C Region are generally underlain by alluvial deposits of Quaternary age. These deposits do contain sand and gravel but not enough is known to delineate material suitable for aggregate. The upper layers of the fans grade downward into older (Pleistocene) more weathered alluvium in which the clast durability varies and the clay content of the matrix is higher. Most of the basin areas classified MRZ-3 are located where this older alluvium, described in the previous section of this report, crops out at the surface; or, are located on distal portions of fans where there is a higher percent of fines.

MRZ-3 areas located in hilly or mountainous terrain are generally underlain by sedimentary deposits of Tertiary age, crystalline basement rock, or volcanic rocks. Very little subsurface or surface data of the type needed to evaluate the suitability of these rocks for use in Portland cement concrete is available. Consequently, these areas are classified MRZ-3 (discussion follows).

Puente Formation

Portions of the Puente Formation, which are exposed in both the San Jose and the Puente hills, have been classified MRZ-3. Available geologic mapping of the La Habra and Yorba Linda quadrangles is the most detailed in the area. Here the Puente Formation has been divided into four members (Durham and Yerkes, 1964; Yerkes, 1972), two of which are classified MRZ-3: the Soquel and the Sycamore Canyon members.

The Soquel Member of Puente Formation consists of poorly cemented feldspathic sandstone and pebbly sandstone, interbedded siltstone, and local lenses of pebble conglomerate. An MRZ-3 classification was given to areas underlain by these sediments mainly on the basis of lithologic descriptions and field observations. In the past, aggregate was produced from a conglomerate lens of the Soquel Member in an area east of El Toro Marine Air Station (located in the adjacent Orange County-Temescal Valley P-C Region). It is not known whether conglomeratic lenses of the Soquel Member within the San Jose and Puente hills have similar physical and chemical properties to those mined in the east El Toro area.

The Sycamore Canyon Member of the Puente Formation consists of fine- to coarse-grained sandstone, pebble conglomerate, and interbedded micaceous sandy siltstone. The relative amounts of conglomerate, sandstone, and siltstone differ considerably throughout its known extent. Consequently, each locality must be evaluated separately in order to determine the potential of this member for aggregate use. Parts of the Sycamore Canyon Member are currently being mined in the adjacent Orange County-Temescal Valley P-C Region near Prado Dam.

Available mapping for the remainder of the San Jose and Puente hills, though less detailed, is still adequate for classification. The middle member of the Puente Formation as mapped by Woodford and others (1944) and the sandstone and conglomerate units of the lower and upper Puente Formation as mapped by Olmsted (1950) have been classified MRZ-3. These units also consist of massive, fine- to coarse-grained sandstone, conglomerate, pebbly conglomerate and interbedded shale and siltstone. The sandstones and conglomerates range from poorly cemented to well cemented.

Topanga Formation

The Buzzard Peak Member of the Topanga Formation, exposed within the central San Jose Hills, has also been classified MRZ-3. It is a conglomerate consisting of pebbles and boulders in an arkosic sandy matrix. The ratio of matrix to clasts is approximately 50/50. These rocks have been assigned an MRZ-3 classification on the basis of lithologic descriptions (Shelton, 1955) and field observations. There is no history of mining.

Glendora Volcanics

The Glendora volcanics are a complex series of flows, shallow intrusive rocks, pyroclastic rocks, and volcanic sediments which are also interbedded with fine grained sediments of the Puente Formation (Shelton, 1955). Twenty types of volcanic rock were described by Shelton, all within the northeastern San Jose Hills and in a small part of the San Gabriel Mountains between San Dimas and Dalton wash (south of Johnstone Peak).

Unaltered and massive flows of basaltic to dacitic composition present within the Glendora Volcanics may be suitable for crushed aggregate. Due to the widespread presence of these flows, and because unaltered basaltic and dacitic volcanic rocks are suitable as demonstrated by the fact that elsewhere in the United States they are used as a source of crushed rock, the Glendora Volcanics were classified MRZ-3.

However, many other rock units within the Glendora Volcanics have been altered so that deleterious chalcedony, opal, and carbonates are found disseminated or as vein and vesicle fillings. Futhermore, many of the units within the Glendora Volcanics consist of extremely fine-grained glass, altered glass, and pumice fragments which are unsuitable for P.C.C. aggregate use. Therefore, the physical and chemical properties of the rocks must be evaluated at each site.

San Gabriel Mountains

The San Gabriel Mountains within this P-C region are composed of a large variety of metamorphic and plutonic rock types. The major rock types classified MRZ-3 include high grade metamorphic rocks, such as quartz-feldspar gneiss and gneissic quartzite, quartz diorite and pegmatitic granite (Cox and Morton, 1978; Morton, 1976; Streitz, 1966). All these may be suitable for crushed aggregate. Because there are unmapped areas underlain by less durable rock types, such as low grade metasedimentary and metavolcanic rocks, the rocks must be evaluated at each site.

Some outliers of crystalline basement rocks are present in the northeastern San Jose and Puente hills, where they were classified MRZ-3.

Those MRZ-3 areas that are most promising as potential sources of aggregate material are discussed in the "Alternative Sources of Aggregate" section.

Areas Classified MRZ-4

Areas where available information is inadequate for any other classification are assigned MRZ-4. No areas were so classified within the Claremont-Upland P-C Region.

EVALUATION OF AGGREGATE RESOURCES IN THE CLAREMONT-UPLAND P-C REGION

An analysis of aggregate supply in the Claremont-Upland P-C Region is presented in this section of the report. Similar evaluations have already been completed for the three adjacent regions (Miller and others, 1981; Kohler and others, 1982; Miller, in progress). Evaluation of all adjacent P-C regions is necessary in order to determine the effects that projected supply and demand in these regions might have on the availability of aggregate in the Claremont-Upland P-C Region. These evaluations are presented in the section titled "Alternative Sources of Aggregate".

A substantial amount of land in the Claremont-Upland P-C Region has been classified MRZ-2 (Plate 6.1). By far, the bulk of the sand and gravel deposits contained within these classified areas occurs beneath urbanized land. Some of the remaining land is unoccupied, but is broken up into isolated parcels by subdivisions, freeways, roads, power lines, and waterways. These unoccupied parcels are, in many cases, too small to be considered for sand and gravel extraction.

Mining Constraints

The quantity of reserves is highly dependent on both regulatory and economic constraints. Non-permitted resources have no regulatory constraints because there is no way of knowing what regulatory changes may take place before these resources become available. Consequently, current constraints should be used only as a starting point and it should be noted that the quantity of non-permitted resources may be drastically reduced or enlarged depending on future constraints.

Regulatory Constraints

The major regulatory restrictions that affect the total sand and gravel reserve deal with slope angle, depth of extraction, and setback requirements. These regulatory constraints are largely imposed by the city or county that has jurisdiction over the mining property, but state and federal government agencies may impose their own special regulations.

The major sand and gravel operations in the Claremont-Upland P-C Region fall under the jurisdiction of the City of Upland and the San Bernardino County Flood Control District. The City of Upland has amended their Municipal Code (December 1981) and adopted regulations providing for the review and approval of reclamation plans and the issuance of permits to conduct surface mining operations. Prior to this, San Bernardino County Flood Control District was the only agency reviewing mining plans. The City has approved the mining plans issued by San Bernardino County Flood Control District for all but one of the current operations. That operator is contemplating some additional reclamation and is in discussions with the City.

In general, the plans issued for operations on the San Antonio fan allow 2:1 slopes. Depth of excavation varies, and is either determined by the operator based on economic considerations or by the mining plan which has established a stepped series of pits for the purpose of groundwater replenishment. In addition to these constraints, the Los Angeles District of the U.S. Army Corps of Engineers requires a 125-foot setback from the San Antonio Flood Control Channel.

South facing slopes on the Cucamonga fan are constrained at an angle of 4:1. Slopes facing the other directions are 2:1. Depth of excavation varies from plan to plan; however, no pit may exceed the depth to a theoretical 10:1 slope drawn from the foot of the Cucamonga Creek flood control dam. There is a 250-foot setback required from the Cucamonga Channel. Minimum setbacks for property on both fans is 50 feet.

Economic Constraints

In classifying sand and gravel deposits as significant and in calculating the available resources and reserves within those deposits, the following conditions involving economic factors must be satisfied:

1. Material meets the mineability and threshold criteria given in the "Guidelines for Classification and Designation of Mineral Lands" (Appendix A-3 in SR 143, Part I).

2. The deposit consists of sound durable material substantially free of chemically reactive substances that would preclude its use as a construction material.

3. Combined clay and silt fraction does not exceed 25 percent by volume.

4. Technology limits extraction to a maximum of 100 feet below the water table.

Resource Sectors

The Concept of Sectors

To organize the volume calculations of the aggregate resources, and to inform the public about the resources within specific land-use areas, the State Geologist has utilized the concept of "sectors" to identify those MRZ-2 areas that meet the Board's guidelines as eligible to be considered for designation as having regional or statewide significance. Each sector shown on Plates 6.13 through 6.18 is a part of the nonurbanized MRZ-2 land where the geometrical configuration of the deposit is fairly uniform, so that tonnages of the mineral resource present can be estimated with some reliability. Some sectors that have been subdivided by highways and other intervening developments have been given sets of sub-sector numbers for ease of identifying individual areas. Where sector boundaries are adjacent to urbanized land, the volume of a 100-foot setback was subtracted from a total volume. The sector concept is used for the convenience of arraying resources information, and is not intended to imply any recommendation for designation or for designation priority. The sector criteria are given in the Appendix, p. 31.

Much of the resource calculation that follows is based on an evaluation of drill-hole records of variable reliability collected over a time span extending back to the early part of this century. The drill-hole records describe the types of earth material (silt, sand, gravel, and bedrock types) encountered at various depths. The quality of drill-hole descriptions range from poor to very good, but only drill-hole records that contain descriptions judged to be acceptable for analysis were used in the present study.

Terminology used to reflect the confidence level of resources has been adopted from U.S. Geological Survey Bulletin 1450-A (Appendix C in SR 143, Part I). For this study, permitted resources (reserves) fall under the category of indicated reserves. Non-permitted resources meet the criteria set forth for either indicated or inferred resources.

A mineral commodity is recoverable only if local regulations permit mining activity. Therefore, sand and gravel resources herein placed in the category of reserves are limited to resources that underlie land where mining is permitted by lead agencies having jurisdiction over such land. The term resources includes both reserves and non-permitted resources (usable materials which could be mined in the future, but for which no use permit allowing extraction has been granted, or for which development has not been definitely established to be feasible based upon current technological or economic conditions).

All sand and gravel deposits suitable for aggregate in the unurbanized part of the Claremont-Upland P-C Region have been divided into five sectors for the purpose of making resource calculations.

Sector A - San Antonio Reservoir. Sector A (Plate 6.13) consists of the annual recharge area upstream from San Antonio Creek Flood Control Dam. Currently two companies are mining aggregate for Portland cement concrete and other uses within this sector. They mine annual replenishment deposits only, maintaining the reservoir capacity at about 8,000 acre-feet for the U.S. Army Corps of Engineers. The Sector, however, extends upstream from the reservoir to include part of the wash that interpretation of water-well logs indicates to be underlain by good resources. These drill holes indicate a thickness of sand and gravel of at least 75 feet; this thickness was used for resource calculations.

Based upon information provided by the sand and gravel companies within the San Antonio Reservoir Area, the following assumptions were made for determining a resource for Sector A:

1. The material is assumed to have an average waste of 5 percent.

2. The in-place density of the resource is assumed to be .059 short tons of sand and gravel per cubic foot (16.9 ft^3 per ton).

3. The pit-wall slopes will not exceed a 1:1 gradient.

Based upon the above assumptions, approximately 40 million tons of resources are estimated to lie beneath Sector A. Of this 40 million tons, approximately 25 million tons of material is believed to be suitable for Portland cement concrete aggregate. Reserves for Sector A were not calculated because they are dependent on the variable yearly runoff.

Sectors B and C - San Antonio and Cucamonga Fans. These two sectors are discussed concurrently because of the similarity of the deposits and the history of operations. Sand and gravel extraction from the upper portions of the San Antonio fan - Sector B (Plates 6.13 and 6.15) - has been occurring since 1909. Currently-active plants began operations in the middle to late 1950s. Extraction from Sector C, which includes the upper portion of the Cucamonga fan (Plates 6.13 - 6.16), began in 1957.

The water-well logs and California Department of Transportation bridge-boring logs used in this study do not extend deep enough to determine the thickness of the alluvial deposits in these fans. However, oil-well logs and other types of subsurface information indicate that the alluvium in Sectors B and C ranges from 300 to 1,000 feet thick (Morton, Plate 5A, 1976). Not all of this thickness is suitable for aggregate. A recently deposited layer of sand and gravel thinly covers older layers of weathered sediments which are clayey and less durable. The depth to this weathered material appears to be highly variable but has been encountered in some of the gravel pits at about 50 to 90 feet. When weathering has not been too intense, the older sediments can be made usable if mixed with the younger deposits.

A depth of 120 and 100 feet for Sectors B and C, respectively, were used in resource calculations. These depths were based on information provided by sand and gravel companies operating within the two sectors. It is assumed that the cleaner young material will be available to mix with and upgrade the older deposits.

The following assumptions were also made based on company information:

1. The material is assumed to have a 15 percent waste factor.
2. The in-place density of the resource is assumed to be .065 short tons of sand and gravel per cubic foot (15.4 ft^3 per ton).
3. Approximately 50 percent of the resource is suitable for Portland cement concrete aggregate.
4. The pit-wall slopes will not exceed a 1:1 gradient.

There are 420 million tons of resources included in Sector B. An additional 190 million tons of resources are included in Sector C. (Table 6.2). In order to protect proprietary information, reserve estimates for Sectors B and C are not given in Table 6.2. The combined total reserves of Sectors B and C is 55 million tons.

SECTOR	RESOURCES (in million short tons)		AREA (In acres)
	PERMITTED RESOURCES (Reserves)	NON-PERMITTED RESOURCES	
A	none	41	198
B	*	420	2,395
C	*	190	985
D	none	680	9,546
E	none	20	186
TOTAL	55	1,350	13,102

Table 6.2 Aggregate resources of the Claremont-Upland P-C Region (all numbers in million short tons).

* Cannot be shown due to confidentiality.

Note: All figures over 50 million rounded to nearest 10 million; Figures less than 50 million rounded to nearest 5 million.

Sector D - Deer and Day Fans. Sector D covers the unurbanized portions of Deer and Day fans (Plates 6.14 and 6.16). Here, industrial parks and some residential districts are encroaching on open and agricultural land. No major sand and gravel pits have been sited here, but one small borrow pit existed in the northwest corner of section 29, Township 1N, Range 6W. This area was classified MRZ-2 and sectorized because the provenance and method of formation are the same as those for the deposits in Sectors B and C where sand and gravel extraction is occurring. This classification is supported by both field observations and drill-hole data, as described in the previous section, "Areas Classified MRZ-2". Drill-hole data available for sub-Sector D-1 show that in this area, sand and gravel extends from the surface to 90 to 100 feet below ground surface. However, limited data available for the remainder of Sector D indicate that possibly only the upper 30 to 40 feet of the deposit consists of suitable sand and gravel.

The following assumptions are the basis of resource calculations for this sector. They are very conservative because of the unproven nature of this area.

1. The material is assumed to have a 20 percent waste factor.

2. The in-place density of the resource is assumed to be .065 short tons of sand and gravel per cubic foot (15.4 ft^3/per ton).

3. Pit-wall slopes will not exceed a 1:1 gradient.

4. Depth of the resource is 30 feet, except in D-1 where it is 90 feet.

Sector E - San Dimas Wash. Sector E consists of the percolation basins, undeveloped parkland and riparian area within the upper, alluviated portion of San Dimas Wash. Sand and gravel extraction is not known to have ever been attempted or permitted here. However, observation of the surface material and drill-hole data indicate the existence of suitable sand and gravel to depths varying from 30 to 100 feet. Sector E is divided into several small sub-sectors which do not individually contain enough aggregate to meet the threshold value; if mined as a group these deposits do meet the threshold value.

The following are the assumptions on which resource calculations for Sector E are based:

1. The material is assumed to have a 20 percent waste factor.

2. The in-place density of the resource is assumed to be .065 short tons of sand and gravel per cubic foot (15.4 ft^3 per ton).

3. Pit-wall slopes will not exceed a 1:1 gradient.

4. Depth of resource is 50 feet in sub-Sectors E-1 through E-5; and 70 feet in sub-Sectors E-6 and E-7 (these are conservative values, based on drill-hole data).

Land-Use Considerations

The resource estimates that have been made for Sectors A-E indicate the total quantity of aggregate material that is geologically available. These estimates do not include land classified MRZ-2 that is currently urbanized. However, they do consider areas which may be committed to a nonurban land use. A prime example of such land is the percolation basin located above the recently constructed flood basin on Cucamonga Creek. This is an excellent resource area for sand and gravel and is included as part of Sector C (sub-Sectors C-1 and C-2). Sand and gravel can be extracted here in a manner consistent with groundwater recharge and flood control.

ESTIMATED 50-YEAR CONSUMPTION OF AGGREGATE

The total projected consumption of aggregate in the Claremont-Upland P-C Region for the next 50 years is estimated to be 245 million tons (Table 6.3). This estimate is based on projected population data and an average per capita use figure, as described in Part I of Special Report 143 under "50-Year Forecasts".

Aggregate Production Records

Aggregate production records were compiled for the years 1960-1980 for the Claremont-Upland area and its adjacent P-C regions (Figures 6.4-6.7). Records for the greater Los Angeles Basin for the years prior to 1960 are, in most cases, incomplete. Aggregate production data was obtained from the United States Bureau of Mines (USBM) statistics. These records are compiled from responses to a questionnaire that is sent out on an annual basis to all known mining operations. Each producer is requested to divulge the amount and value of its annual production for the preceding year. It is important to note that the degree of accuracy of these statistics depends strictly on the correctness of the producer's response. The Division of Mines and Geology (DMG) staff did not seek to verify production data, or get production data from companies who did not respond to the U.S. Bureau of Mines inquiries.

Population Records

Population data for the Claremont-Upland area and its adjacent P-C regions were also compiled for the years 1960-1980. (Figures 6.4-6.7). The historical population data for this period was obtained from

PROJECTED AGGREGATE CONSUMPTION FOR
CLAREMONT-UPLAND P-C REGION

Years	Average Population (millions)	5-Year Per Capita (tons)	Aggregate Consumption (million tons)
1982-1986	.54	35.85	20
1987-1991	.58	35.85	21
1992-1996	.61	35.85	22
1997-2001	.64	35.85	23
2002-2006	.67	35.85	24
2007-2011	.70	35.85	25
2012-2016	.73	35.85	26
2017-2021	.76	35.85	27
2022-2026	.79	35.85	28
2027-2031	.82	35.85	29
TOTAL			245

PROJECTED AGGREGATE CONSUMPTION
FOR ADJACENT P-C REGIONS
(million short tons)

San Gabriel Valley (1980-2030):	780
Orange Co. - Temescal Valley (1980-2030):	844
San Bernardino (1980-2030):	470

Table 6.3 Projected aggregate consumption (in million short tons) for Claremont-Upland and adjacent P-C regions

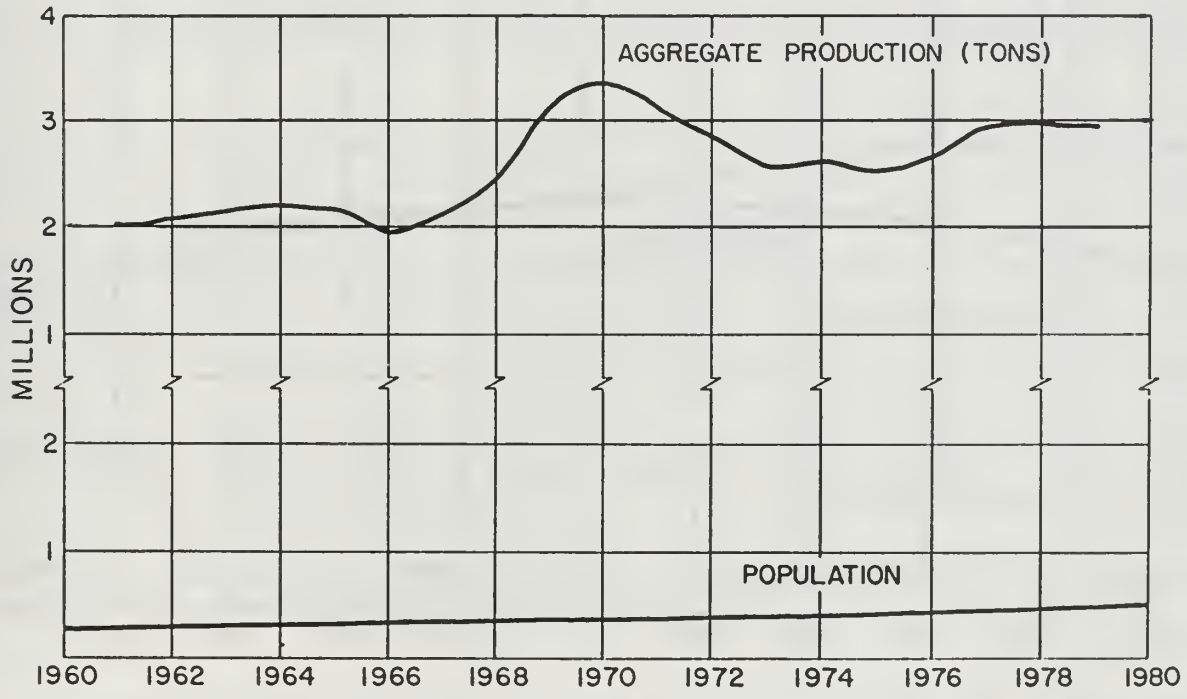

Figure 6.4 Claremont-Upland P-C Region: population and aggregate production for years 1960-1980.

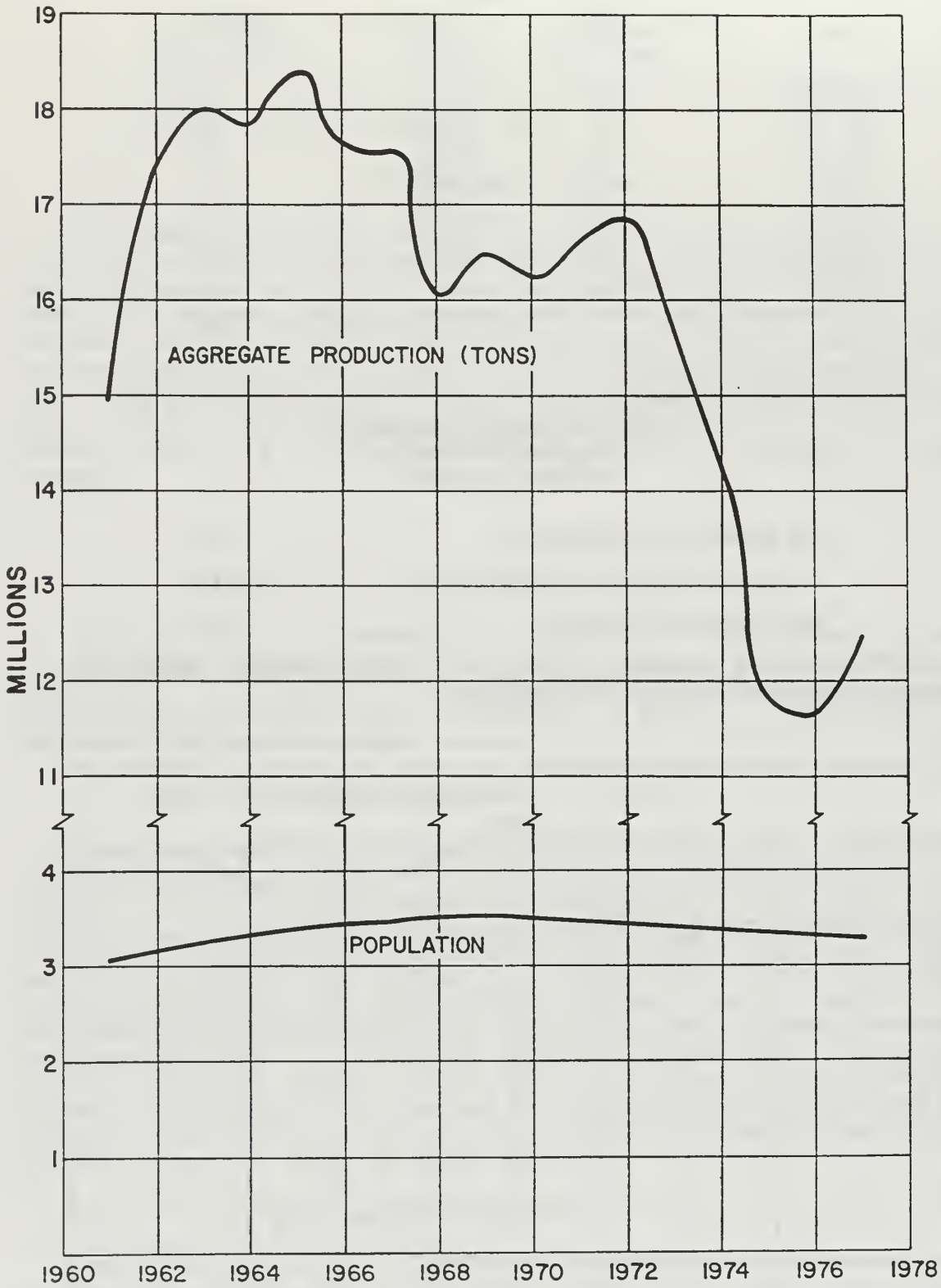

Figure 6.5 San Gabriel Valley P-C Region: population and aggregate production for years 1960-1977.

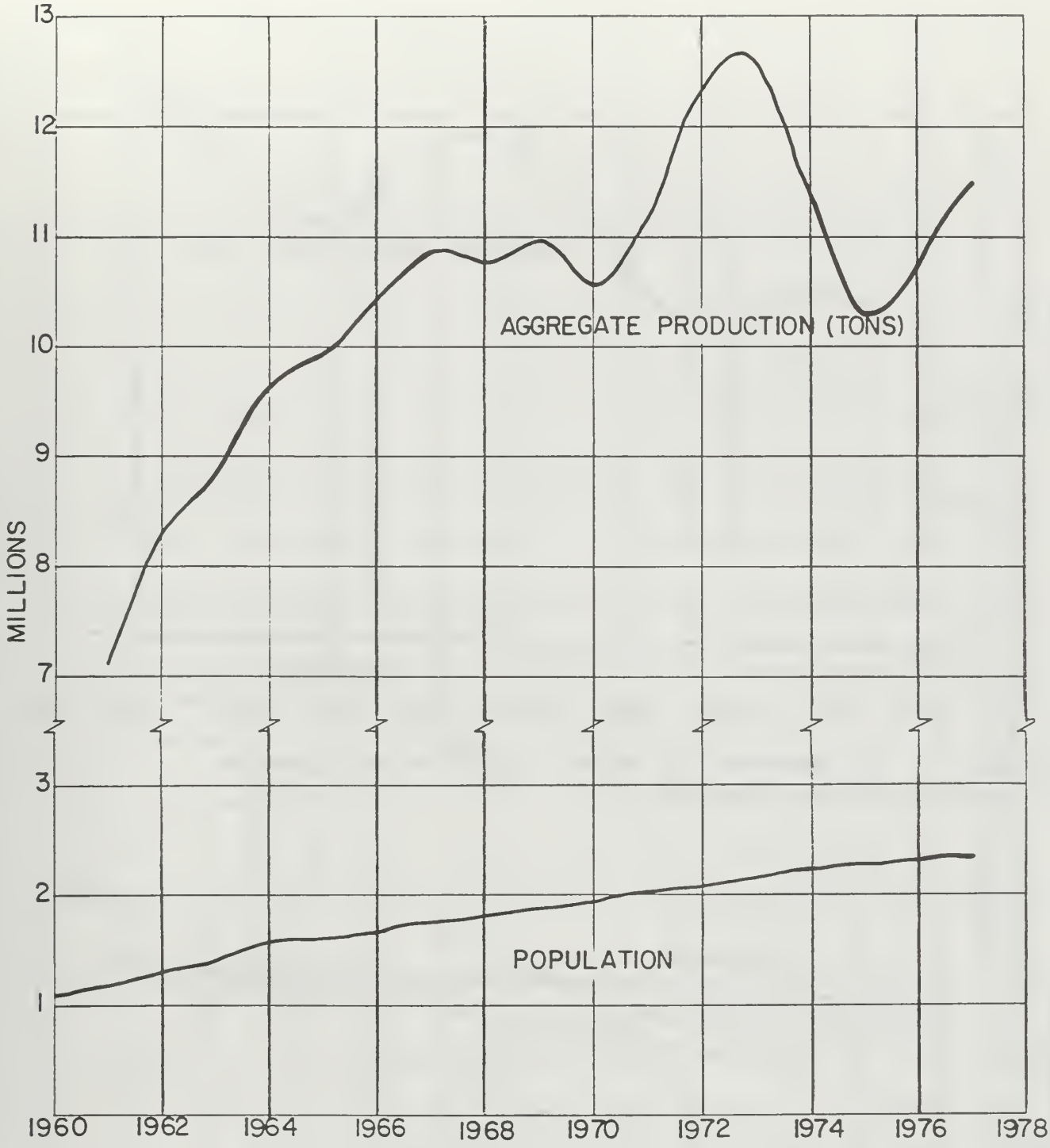

Figure 6.6 Orange County-Temescal Valley P-C Region: population and aggregate production for years 1960-1977.

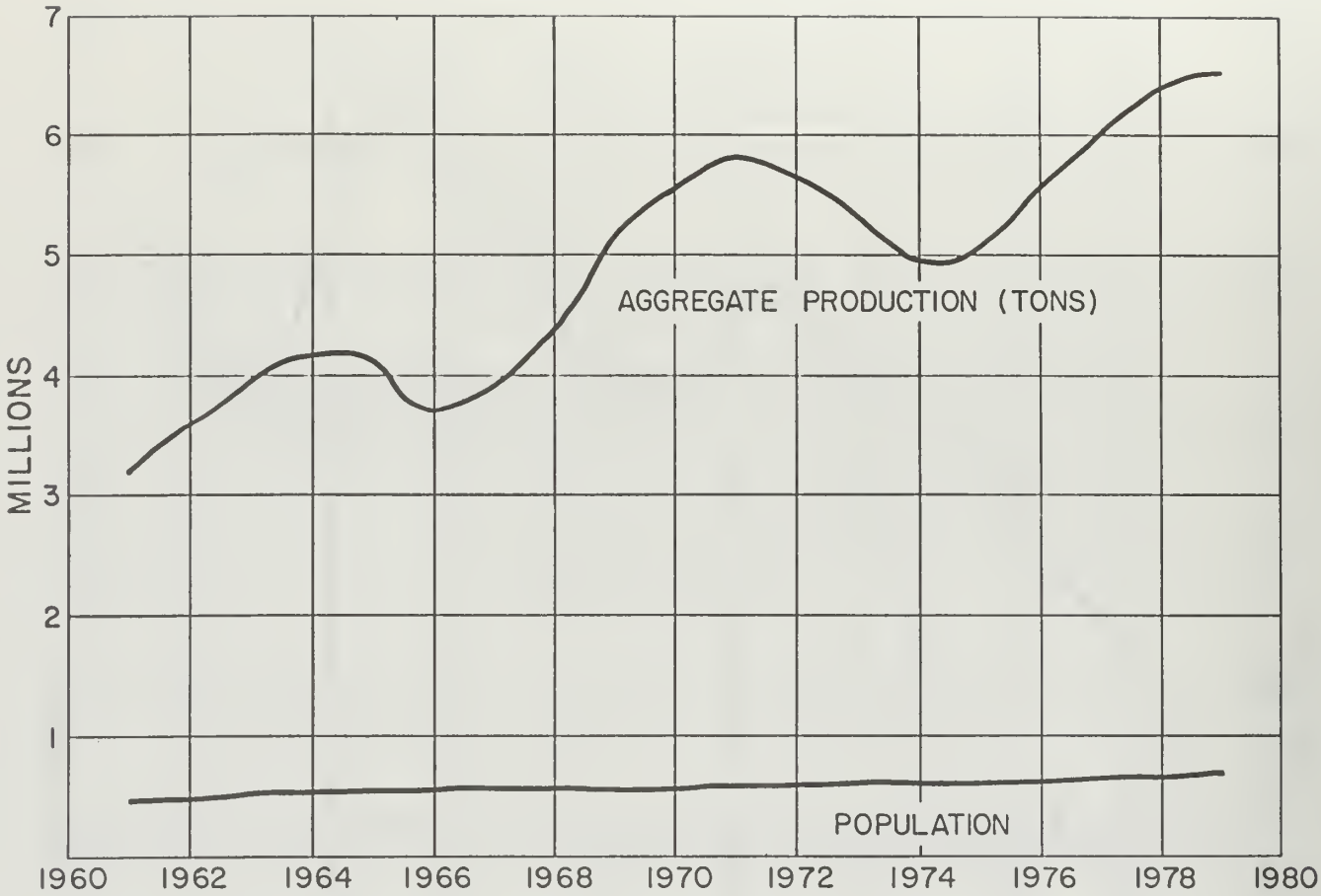

Figure 6.7 San Bernardino P-C Region: population and aggregate production for years 1960-1979.

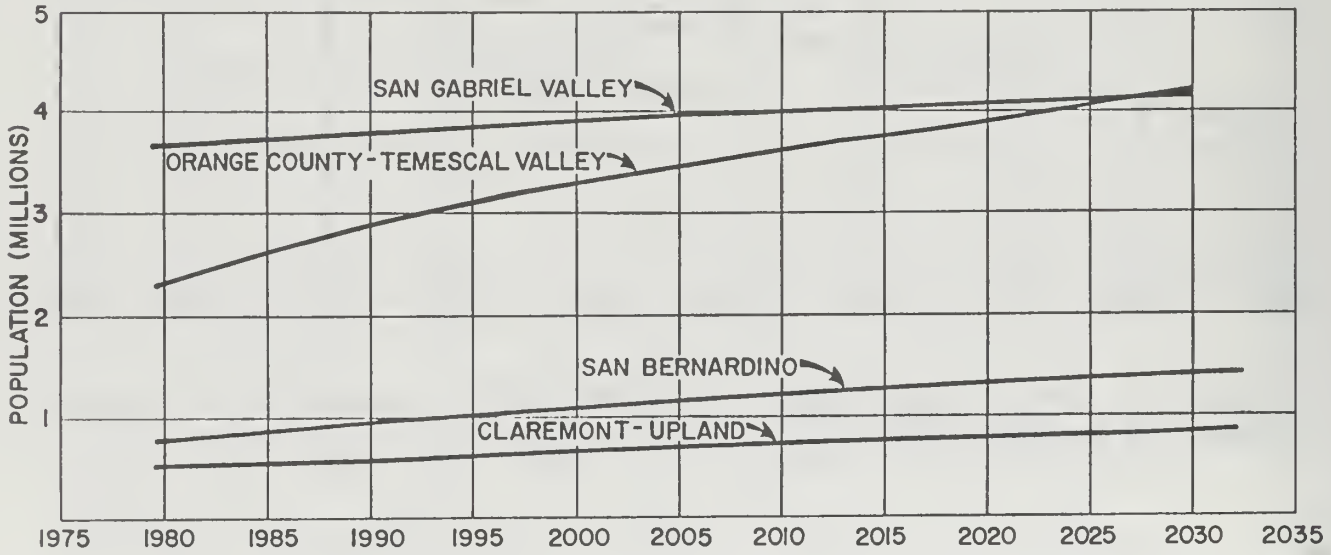

Figure 6.8 Projected population of the Claremont-Upland, San Gabriel Valley, Orange County-Temescal Valley, and San Bernardino P-C regions.

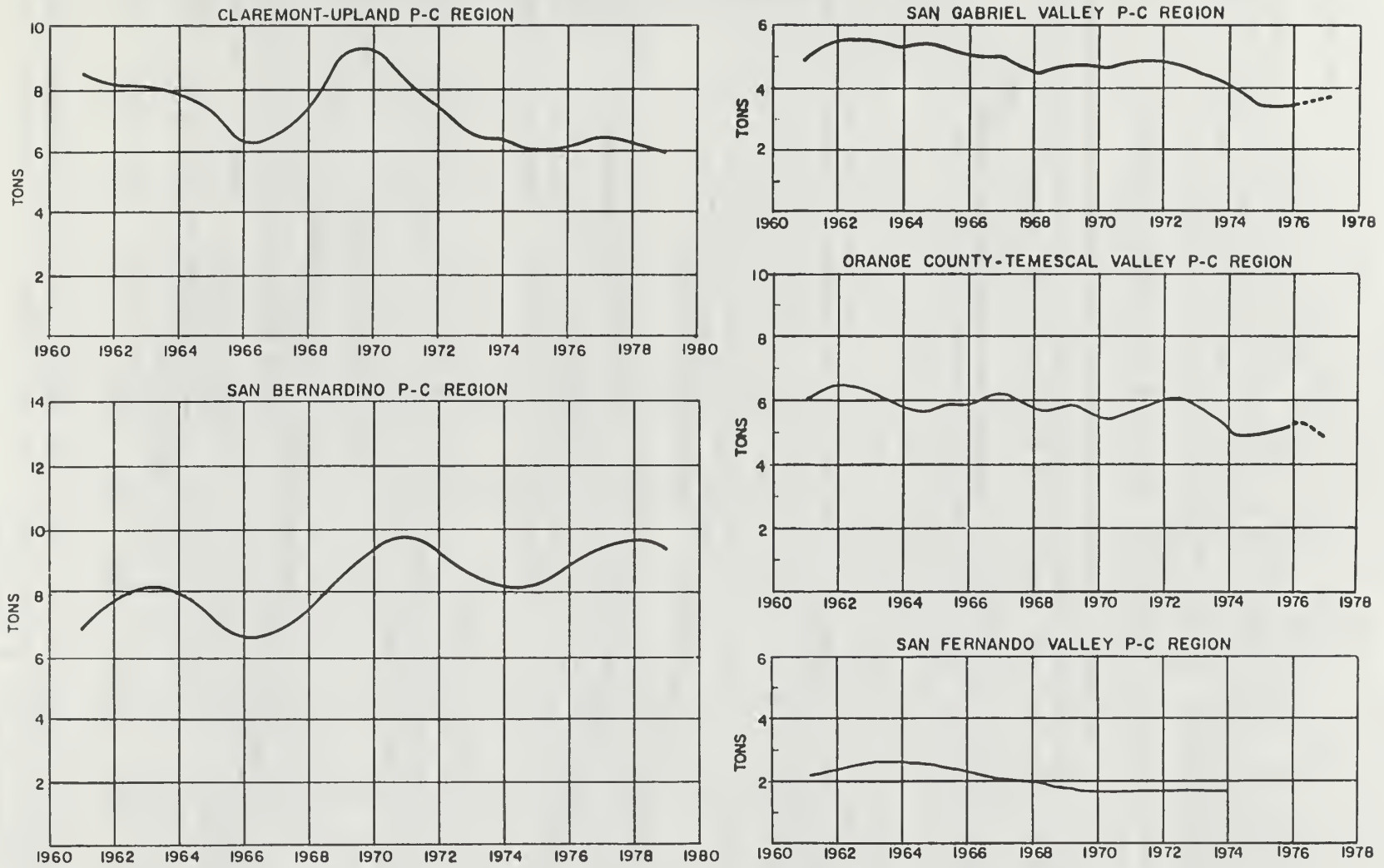

Figure 6.9 Annual per capita consumption of aggregate in the Claremont-Upland, San Gabriel Valley, Orange County- Temescal Valley, San Bernardino, and San Fernando Valley P-C regions.

statistical bulletins that have been published by Los Angeles and San Bernardino counties on a quarterly or an annual basis.

Population projections for the years between 1981 and 2020 were compiled for the P-C region from area projections furnished by the State Department of Finance (DOF, 1977), and the Southern California Association of Governments (SCAG, 1982). Population projections for the 11-year period between 2020 and 2031 were extrapolated by DMG staff by a straight-line continuation of the compiled projections. Population projections through the year 2031 are presented in Figure 6.8.

Per Capita Consumption Rates and Population Densities

Per capita consumption rates of aggregate have varied through time and may be different in each P-C region (Figure 6.9). Several factors, such as changes in urban growth with time, relative degrees of urban maturity, and proximity to major construction projects (for example, freeways), as well as errors in recordation of aggregate production, account for some of the variations and differences.

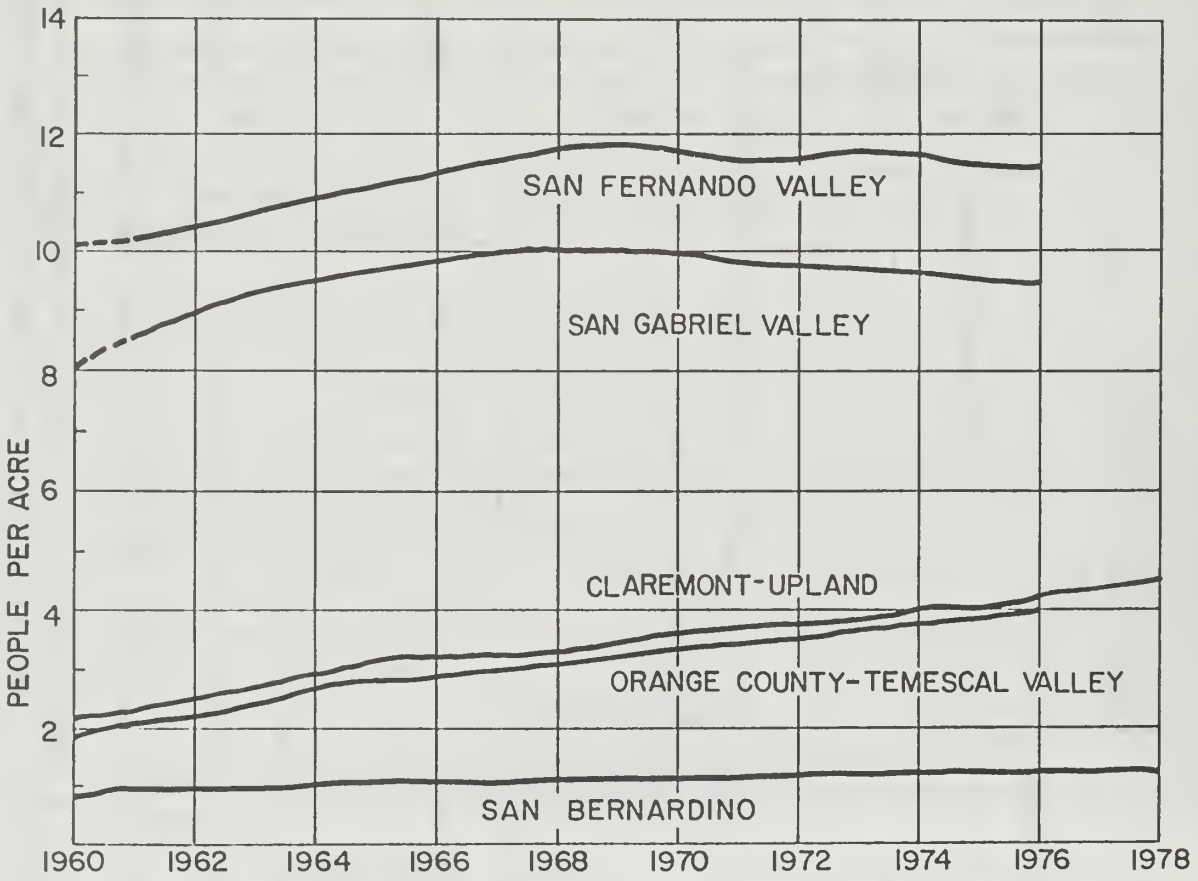

Figure 6.10 Comparison of population densities for the Claremont-Upland, San Gabriel Valley, Orange County-Temescal Valley, San Bernardino, and San Fernando Valley P-C regions.

The historical per capita consumption rates shown on Figure 6.9 were obtained from the yearly aggregate production data and the county population data described in preceding paragraphs. An average per capita consumption of about 7.17 tons of aggregate per person per year was determined for the Claremont-Upland P-C Region from the annual rates.

Compared with the San Gabriel Valley and San Fernando Valley P-C regions, the historical per capita use is much greater and the population density (Figure 6.10) much lower in the Claremont-Upland P-C Region. This suggests that the current P-C region has not reached urban maturity (this is the point at which construction materials are used primarily to maintain what has already been developed rather than to supply further development). In fact, much land still remains open or agricultural, and other areas are developed only at a low density. Therefore, the per capita consumption rate is not expected to diminish within the next 50 years.

Thus, the total projected consumption of aggregate from 1982 to 2031 (Table 6.3) was determined from the average historical per capita consumption rate and the projected population estimates obtained from DOF and SCAG. Events such as massive urban renewal or disaster reconstruction would result in a sharp increase in per capita consumption of aggregate during the period of active reconstruction. The amount of aggregate needed in addition to the projected consumptions would depend upon the extent and duration of reconstruction. Per capita consumption would probably then gradually return to a maintenance level equivalent to that which existed before reconstruction began.

ALTERNATIVE SOURCES OF AGGREGATE

Aggregate sources available for future use are not necessarily limited to the resources within the sectors described under "Resource Sectors" in this report. For example, as more is learned about the quality of materials in areas now classified as MRZ-3, some of that material may prove to be of value as aggregate.

Potential alternatives to those sources of aggregate described in Sectors A-E occur in areas within and near the Claremont-Upland P-C Region. These sources include reserves in adjacent P-C regions, and areas underlain by crystalline rock, older Tertiary sedimentary deposits, and Holocene alluvial deposits within the P-C region.

Except for the resources in adjacent P-C regions, too little is known about the physical and chemical characteristics (see "Overview of Aggregate" section in SR 143, Part I) of many of the alternative sources of aggregate to permit resources estimates. However, a general discussion about the potential resources, their occurrence, and factors controlling their utilization is presented in the following section.

Sand and Gravel Resources of Adjacent P-C Regions

Resource Estimates

Three other P-C regions border Claremont-Upland. Resource estimates for two of the regions, San Gabriel Valley and Orange County-Temescal Valley, were obtained from published reports (Kohler, and others, 1981; Miller, and others, 1981). A sand and gravel classification report for the third region, San Bernardino, is in progress (Miller, 198?). A resource estimate for this area was obtained from the author. These estimates are summarized in Table 6.4. Resource areas within these P-C regions and their distance from Claremont-Upland is shown on Plate 6.17.

P-C REGION	TOTAL PROJECTED 50-YEAR CONSUMPTION (million tons)	RESERVES (million tons)/ DEPLETION DATE	RESOURCES (million tons)
Claremont-Upland	245	55/1997	1,350
San Gabriel	780	280/2000	3,060
Orange Co.- Temescal Valley	844	257/2001	1,200
San Bernardino	476	430/2025	10,000

Table 6.4 Summary of 50-year consumption, reserves and resources in Claremont-Upland and its three neighboring P-C regions.

Estimated 50-Year Consumption of Aggregate in Adjacent P-C Regions

Estimated 50-year aggregate needs for adjacent P-C regions are presented on Table 6.3 and again on Table 6.4. A look at Table 6.4 shows that the projected 50-year total consumption of aggregate for each of the three adjacent P-C regions exceeds their reserve estimates. Of the four P-C regions under discussion only San Bernardino comes close to having sufficient reserves. It is approximately 23 highway miles from the closest operating plants along Lytle Creek in San Bernardino P-C Region to the center of the Claremont-Upland P-C Region (the intersection of Euclid and I-10). Importing aggregate from this P-C Region would not only significantly increase the cost of development in Claremont-Upland, but also seriously deplete the reserves of San Bernardino.

Crushed Rock Sources as Alternative

Metamorphic, granitic, and volcanic rocks are exposed over large areas within and near the Claremont-Upland P-C Region. These areas are potential sources of crushed rock for use as aggregate material. The prospective resource areas located within the Claremont-Upland P-C Region are zoned MRZ-3. In addition, the most prospective crushed rock resource areas occur within the San Gabriel Mountains north of the P-C region.

Metamorphic and Granitic Rocks

Metamorphic and granitic basement rocks of the San Gabriel Mountains and San Jose Hills may provide an alternative source of construction-grade sand and gravel. Most of this exposed basement rock occurs outside of the Claremont-Upland P-C Region, but is close enough to be considered an alternative source of aggregate. Almost all of the alluvial sand and gravel within MRZ-2 areas of the P-C region was derived from this basement terrain. Therefore, it is likely that a large portion of these basement rocks are suitable for Portland cement concrete aggregate. Nevertheless, exploration, including detailed field mapping and testing, is necessary to delineate areas where basement rocks of suitable quality occur. Quality specifications of these rocks are discussed by Anderson and others (1979, p. 28).

Tertiary Volcanic Rocks

Tertiary volcanic rocks are exposed within the northeastern San Jose Hills and the southern front of the San Gabriel Mountains near the City of Glendora (Glendora Volcanics). Some of these volcanic rocks are crystalline lava basalts which may be suitable for aggregate but have not yet been tested. An additional discussion of Tertiary volcanic rocks is contained in a report by Anderson and others (1979, p. 29).

Tertiary Sedimentary Rocks as Alternative

Tertiary sedimentary rocks that may have potential for aggregate use include sandstones and conglomerates from the Topanga Formation and the Soquel and Sycamore Canyon members of the Puente Formation. A discussion of all these formations is given in the "Areas Classified MRZ-3" section

of this report. Mining in the Sycamore Canyon Member of the Puente Formation is currently taking place within the adjacent Orange County-Temescal Valley P-C Region (Miller and others, 1981). Mining of the Soquel Member of the Puente Formation has formerly taken place within the Orange County-Temescal Valley P-C Region. Although the quality of these Tertiary rocks have not been thoroughly evaluated, material produced from these deposits often is of lower quality aggregate and is predominantly used for base, fill, and asphaltic concrete.

Holocene Alluvial Deposits as Alternative

Nonurbanized land in the upper washes of Demens and East Etiwanda canyons may be a potential alternative resource (Plate 6.4, Cucamonga Peak Quadrangle). These are both active washes where fresh aggregate material is deposited during flood periods. The surface material is durable and the soil gray in color. However, there is no known history of mining nor any subsurface data to indicate depth and extent of the deposit in these areas. Consequently, they have been classified MRZ-3. Assuming a resource depth of 75 feet and the same assumptions for resource calculations as those used in Sectors B-D, an estimated 10 million short tons of aggregate material could be produced from this area. This figure would be increased if annual recharge of the deposits are significant.

The land classified MRZ-3 in Day Canyon Wash is similar to the areas described above and to Sector D except that it is uplifted along the Cucamonga fault. Therefore, of the deposits included within this area most are probably older than those adjacent areas classified MRZ-2. However, useable material may be located here. If the material is found to be of suitable quality an estimated 25 million tons of aggregate material could be produced from this area using the same assumptions for resource calculations as those used in Sector D.

Foundation-boring reports for the U.S. Army Corps of Engineers flood control project on Deer Creek were used to estimate a resource depth of 90 feet in sub-Sector D-1. Resources in sub-Sector D-16, which was formed in the same geologic environment and from the same types of source rocks as D-1, may also extend to 90 feet. Unfortunately, because no data is available to confirm this, volume calculations were based on a more conservative estimate of 30 feet. The potential additional 60 feet of deposit in D-16 constitutes another alternative resource.

CONCLUSIONS

An estimated 1,350 million tons of aggregate resources exist in the Claremont-Upland P-C Region. However, current reserves available in the Claremont-Upland P-C Region are not adequate for supplying construction aggregate for the region's population for the next 50 years. Based on a projected population increase for the region and the projected per capita consumption, approximately 245 million tons of aggregate will be required to satisfy demand through the year 2031. Only 55 million tons of aggregate reserves remain within the Claremont-Upland P-C Region (Table 6.2), an amount which is projected to be depleted in approximately

10 years. The 190 million-ton deficit can be supplied by (1) extending the operating life of existing operations where resources are available adjacent to permitted mining; (2) opening new operations; and/or (3) importing material from adjacent areas.

A glance at the reserve figures for the adjacent P-C regions (Table 6.4) shows that all three have inadequate reserves to meet their respective total projected 50-year requirements. San Bernardino P-C Region, just east of Claremont-Upland, most closely meets its future needs. Both the Claremont-Upland P-C Region and the eastern portion of the Orange County-Temescal Valley P-C Region may import material from San Bernardino, thus depleting its supply of reserves. Also, the cost of hauling aggregate from outside the P-C region will be high. Thus, it is evident that some of the approximately 1,350 million tons of non-permitted aggregate resources in the Claremont-Upland P-C Region should be made available for extraction over the next 50-year period to keep the costs of construction aggregate down.

SUMMARY OF DESIGNATION FACTORS

All of the region's permitted reserves are located within Sectors B and C. These reserves are nearly depleted. Non-permitted resources within these sectors are significant both in size and location--central to the developing portion of the basin and adjacent to proven reserves. Estimated non-permitted resources contained within these two sectors total 610 million tons. Together with the 55 million tons of reserves, these two sectors could cover the requirements for the next 50 years.

Sector D contains no reserves but contains an estimated 680 million tons of non-permitted resources. Development pressure is almost as great here as in Sectors B and C. Because the sand and gravel resource in most of Sector D is estimated to be only 30 feet thick, large acreages may be required to develop an economic quarry operation. The land north of Baseline Road in Sector D, being higher on the fan, might contain more than a 30-foot thickness of useable material, and so would seemingly be the most attractive area for mining in this sector. Subsurface data from the U.S. Army Corps of Engineers indicates 90 feet of resource within and upstream from the mouth of Deer Canyon in Sector D.

ACKNOWLEDGMENTS

The Division of Mines and Geology gratefully acknowledges the full cooperation of local government agencies, organizations, and aggregate producers called upon for information during the course of this study. Special thanks are extended to the Southern California Rock Producers Association; the San Bernardino County Flood Control District; the planning departments of Los Angeles County and the cities of Upland and Rancho Cucamonga; the Los Angeles District of the U.S. Army Corps of Engineers; the Southern California Association of Governments; and the California Department of Water Resources.

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APPENDIX

Interim Criteria for Sectorization of MRZ-2 Areas for Aggregate

The purpose of sectorizing MRZ-2 areas is to provide a semi-quantified estimate of construction aggregate resources which are likely to be available to satisfy society's needs during the next 50 years. This estimate, when compared to DMG projected needs for the next half century, provides the context for communities to plan for future resource availability in their land-use policies. The determination of sectors is intended for the use of the State Mining and Geology Board in identifying areas which are candidates for designation under SMARA. The development of sectors provides a perception of future mineral resource availability in the face of future needs and also portrays where these available minerals are generally located. This information is distributed by the Board to all affected lead agencies to provide them with the data necessary to plan for future resource availability in their land-use policies.

Areas within MRZ-2 classifications are sectorized if they have current land uses which are similar to those in areas which have been feasible mineral extraction in the past. Areas within MRZ-2 classifications which have generally not been available for surface mining in the past for specified social or economic reasons are not sectorized. Since such areas are unlikely to be used for surface mining during the foreseeable future, their inclusion in estimates of future resource availability would be misleading.

The estimation of future mineral resource availability in sectors is not a precise analysis, but rather is the best general estimate which can be made with the data presently available. Areas within and outside sectors, can be used for mining or other land uses at the discretion of the local governments which are charged with responsibility for making land-use decisions. Establishment of sectors in no way infringes on this authority. Rather, it provides a perception of future mineral resource availabilities in the face of future needs and also portrays where these available minerals are generally located.

The following criteria will be used by DMG in identifying mineral resource areas which are available for future use. These criteria, in conjunction with the geologic and geometric characteristics of specific mineral deposits will be used in sectorizing MRZ-2 areas. Use of these criteria will assure that sectors contain geologically homogeneous mineral deposits that, based upon current land use, are available for future use.

These land-use criteria are interim and will be used on a trial basis by DMG to evaluate their usefulness. DMG will provide the SMGB with formal recommendations concerning these criteria early in fiscal year 1983-84.

The following specific land uses are considered to be generally incompatible with mining and will thus be excluded from sectors. Mineral resource areas containing land uses not specifically listed will be considered for sectorization. The criteria are to be applied only to lands classified as MRZ-2.

There are two general categories of exclusion: I) Economic Exclusion, and II) Social Exclusion. These exclusions will be applied to land uses that exist at the time the classification report is being prepared. The exclusions will not be applied to proposed or planned land uses.

I) Economic Exclusion

Specific excluded land uses are:

1) Residential areas
2) Commercial areas with land improvements (buildings)
3) Industrial areas (buildings and adjacent needed storage and parking facilities)
4) Major public or private engineering projects, including:

    a) canals
    b) freeways
    c) bridges
    d) airports and associated developments such as parking lots
    e) dams
    f) railroads
    g) major pipelines
    h) major power transmission lines

II) Social Exclusion

Specific excluded land uses are:

1) Cemeteries
2) Geologic Scientific Zones
3) Public parks, developed historical sites and structures, and public recreation areas of all types
4) Public or private schools, institutions, hospitals, and prisons, including adjacent grounds and related structures
5) Military bases and reservations

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MINERAL LAND CLASSIFICATION OF THE GREATER LOS ANGELES AREA

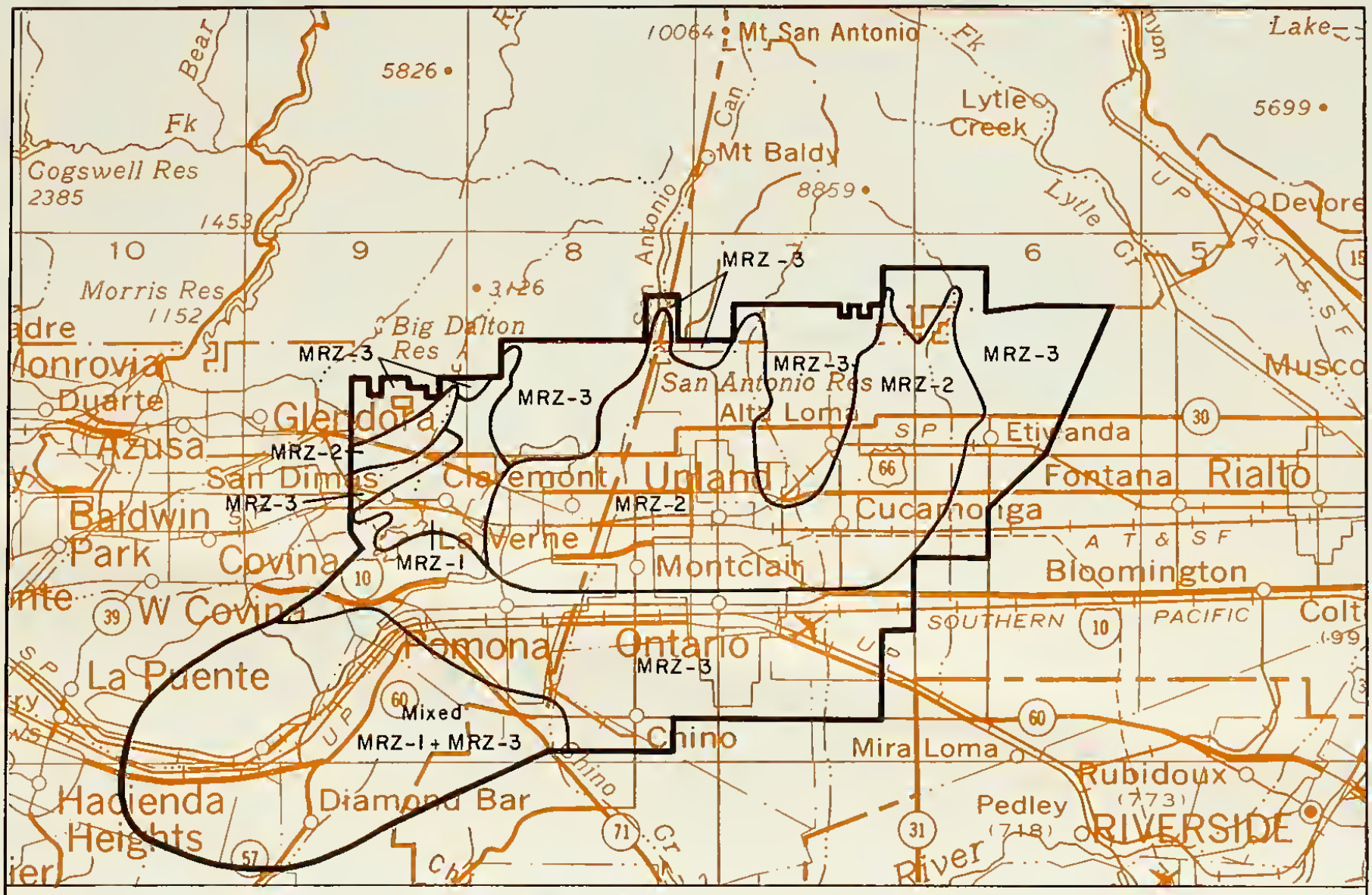
SPECIAL REPORT 143 – PART VI

1987

DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA—GEORGE DEUKMEJIAN, GOVERNOR
THE RESOURCES AGENCY—GORDON K. VAN VLECK, SECRETARY
DEPARTMENT OF CONSERVATION—RANDALL M. WARD DIRECTOR

SPECIAL REPORT 143
PLATE 6.1



Base map enlarged from U.S.Geological Survey at a scale of 1:500,000.

Graphics by C. R. Owens

SCALE 1:230,000

0 1 2 3 4 5 10 15 MILES

0 1 2 3 4 5 10 15 20 KILOMETERS

N

EXPLANATION

MRZ-1 — Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.

MRZ-2 — Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood exists for their presence.

MRZ-3 — Areas containing mineral deposits the significance of which cannot be evaluated from available data.

MRZ-4 — Areas where available information is inadequate for assignment to any other MRZ-Zone.

PRODUCTION-CONSUMPTION REGION BOUNDARY

GENERALIZED AGGREGATE RESOURCE CLASSIFICATION MAP

CLAREMONT-UPLAND PRODUCTION-CONSUMPTION REGION

By Judy Wiedenheft Cole

1983

DIVISION OF MINES AND GEOLOGY
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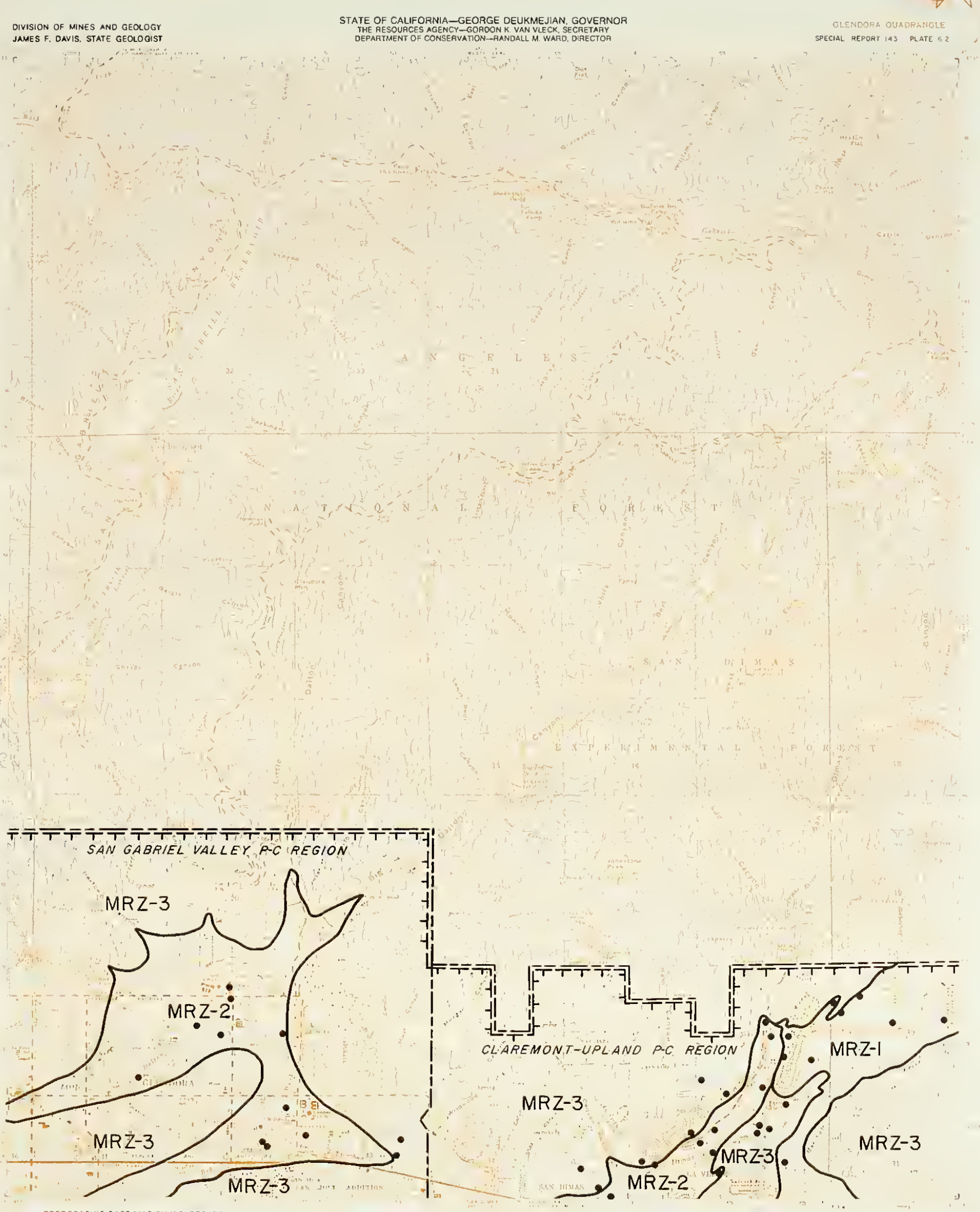
GLENDORA QUADRANGLE
SPECIAL REPORT 143 PLATE 6.2



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

Graphics by James D. Williams and Dale M. Stickney

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION. Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- PRODUCTION-CONSUMPTION REGION BOUNDARY (see text for discussion)
- MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
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- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

GLENDORA QUADRANGLE

By
Judy
Wiedenheft
Cole

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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MT BALDY QUADRANGLE

SPECIAL REPORT 143 PLATE 6.3

CLAREMONT - UPLAND P-C REGION

MRZ-1

MRZ-3

MRZ-3

MRZ-3

MRZ-2

A

A'

Note:
Geologic cross sections are shown on Plates 6.19a and 6.19b. Arrow on geologic cross section indicates section line extends onto adjacent quadrangle.

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

Graphics by Chuck R. Owens and Dale H. Stickney

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

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See text for additional explanation of MRZ Symbols.

MT. BALDY, CALIF.

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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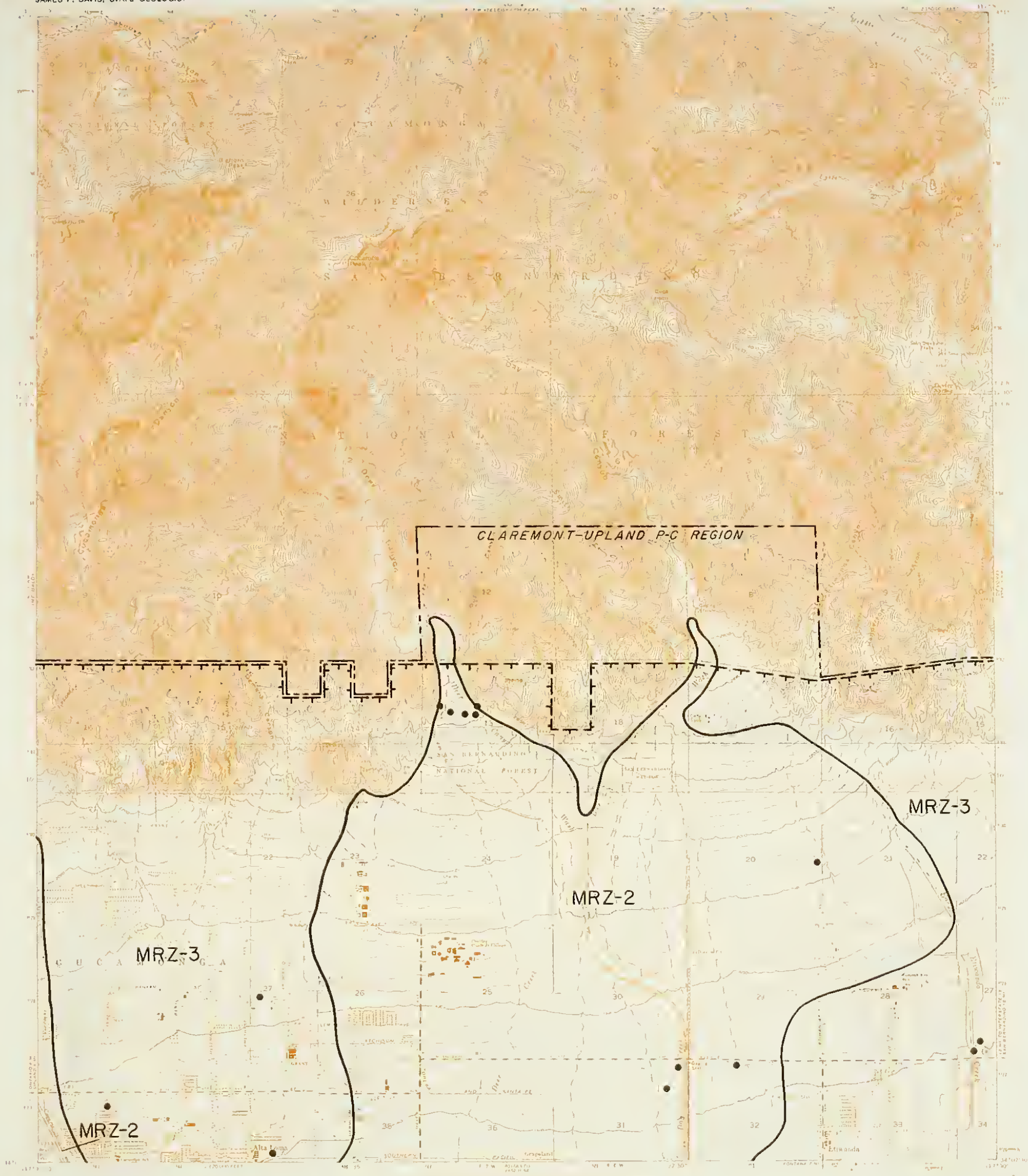
CUCAMONGA PEAK QUADRANGLE

SPECIAL REPORT 143 PLATE 6.4



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

CONTOUR INTERVAL 40 FEET

Graphics by Chuck R. Owens and Dale M. Stickney

CUCAMONGA PEAK, CALIF.

EXPLANATION

- Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
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PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

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See text for additional explanation of MRZ Symbols

By
Judy
Wiedenheft
Cole

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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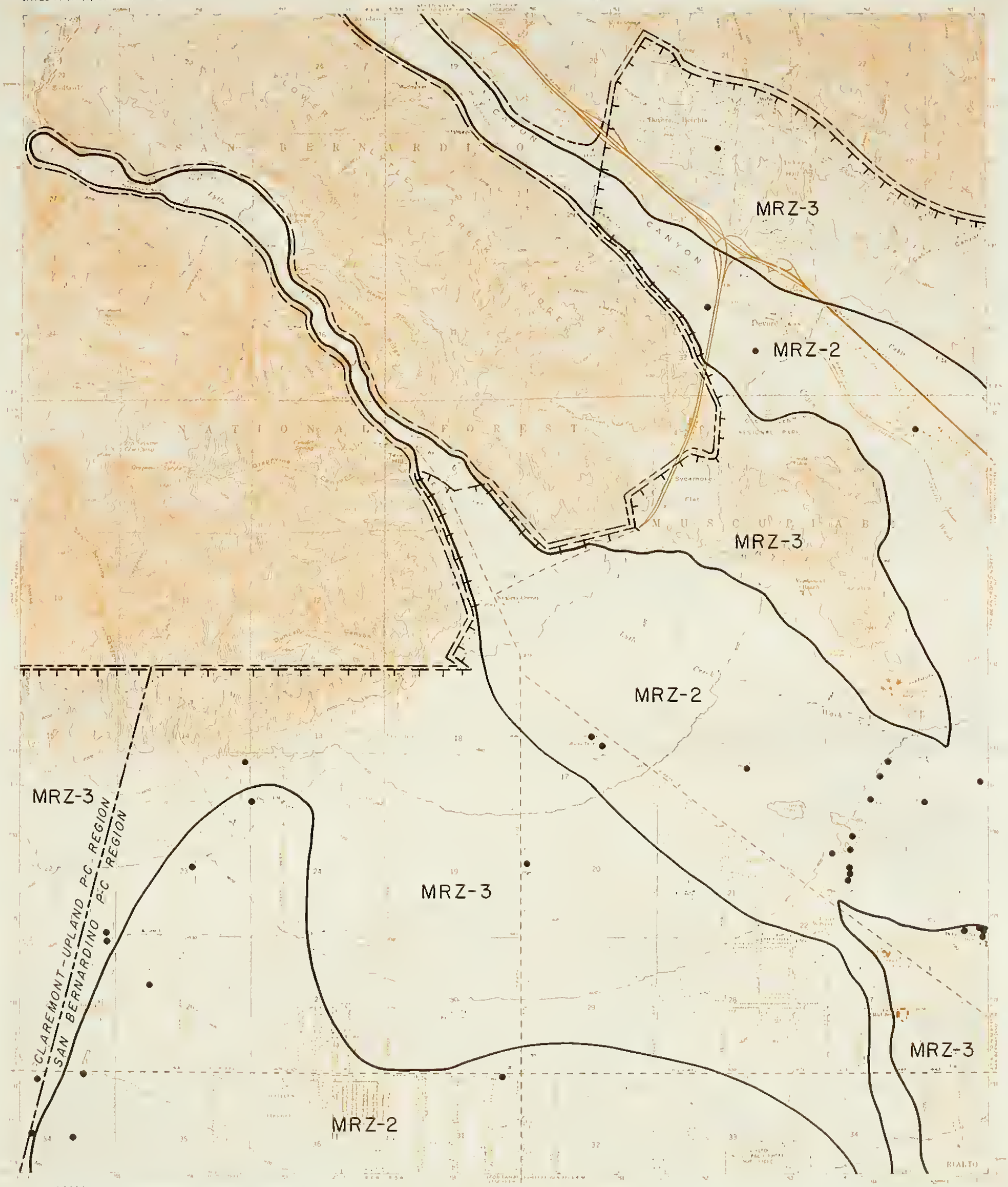
DEVORE QUADRANGLE

SPECIAL REPORT 143 PLATE 6.5



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
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DEVORE, CALIF.

EXPLANATION

- Drill hole

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PRODUCTION-CONSUMPTION REGION BOUNDARY
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See text for additional explanation of MRZ Symbols

By
Judy
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MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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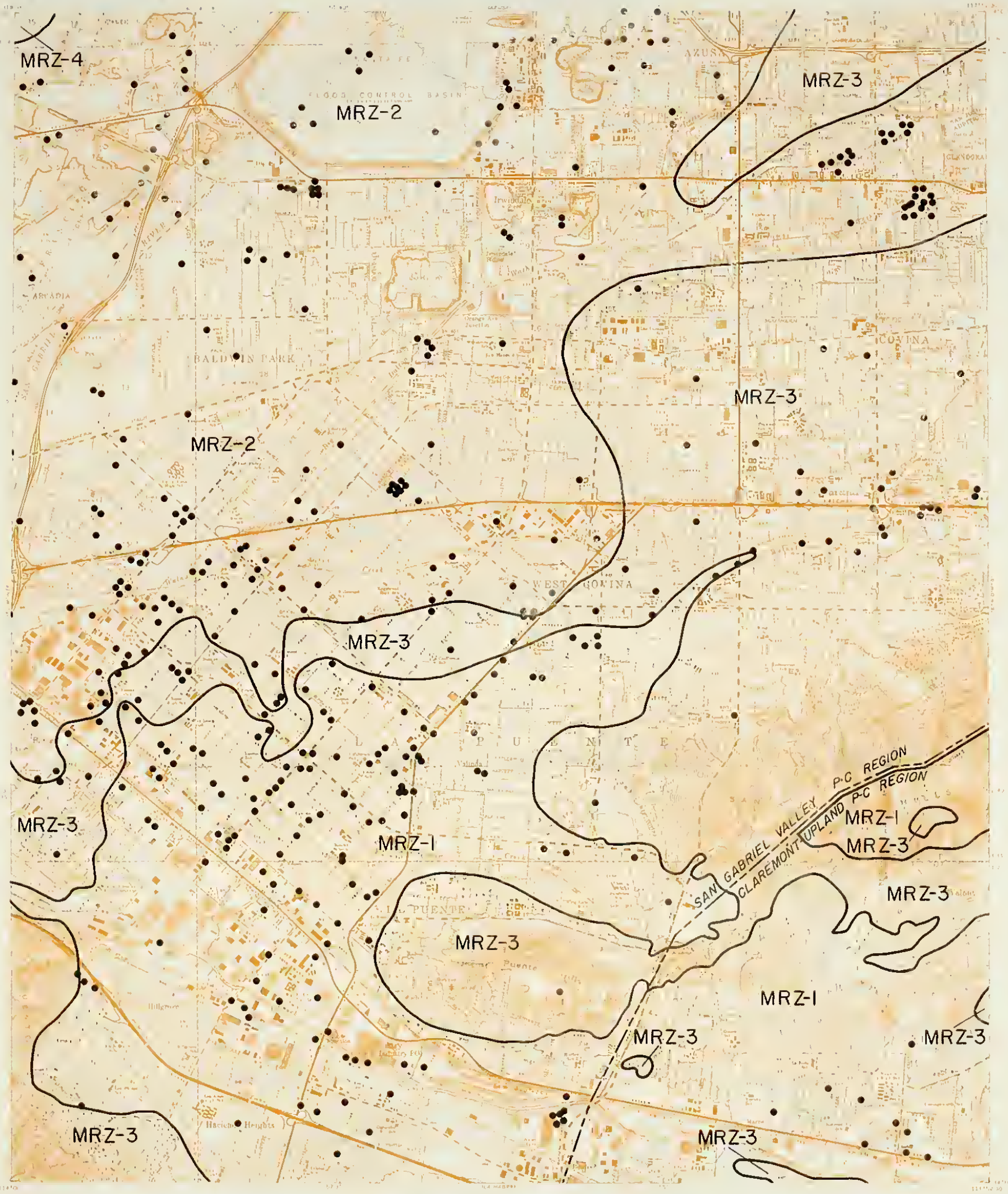
BALDWIN PARK, CALIF.
SPECIAL REPORT 143 PLATE 6.6



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Graphics by Chuck R. Owens and Dale H. Steitney

EXPLANATION

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By
Judy
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MINERAL LAND CLASSIFICATION MAP

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Cloremont-Uplond P-C Region

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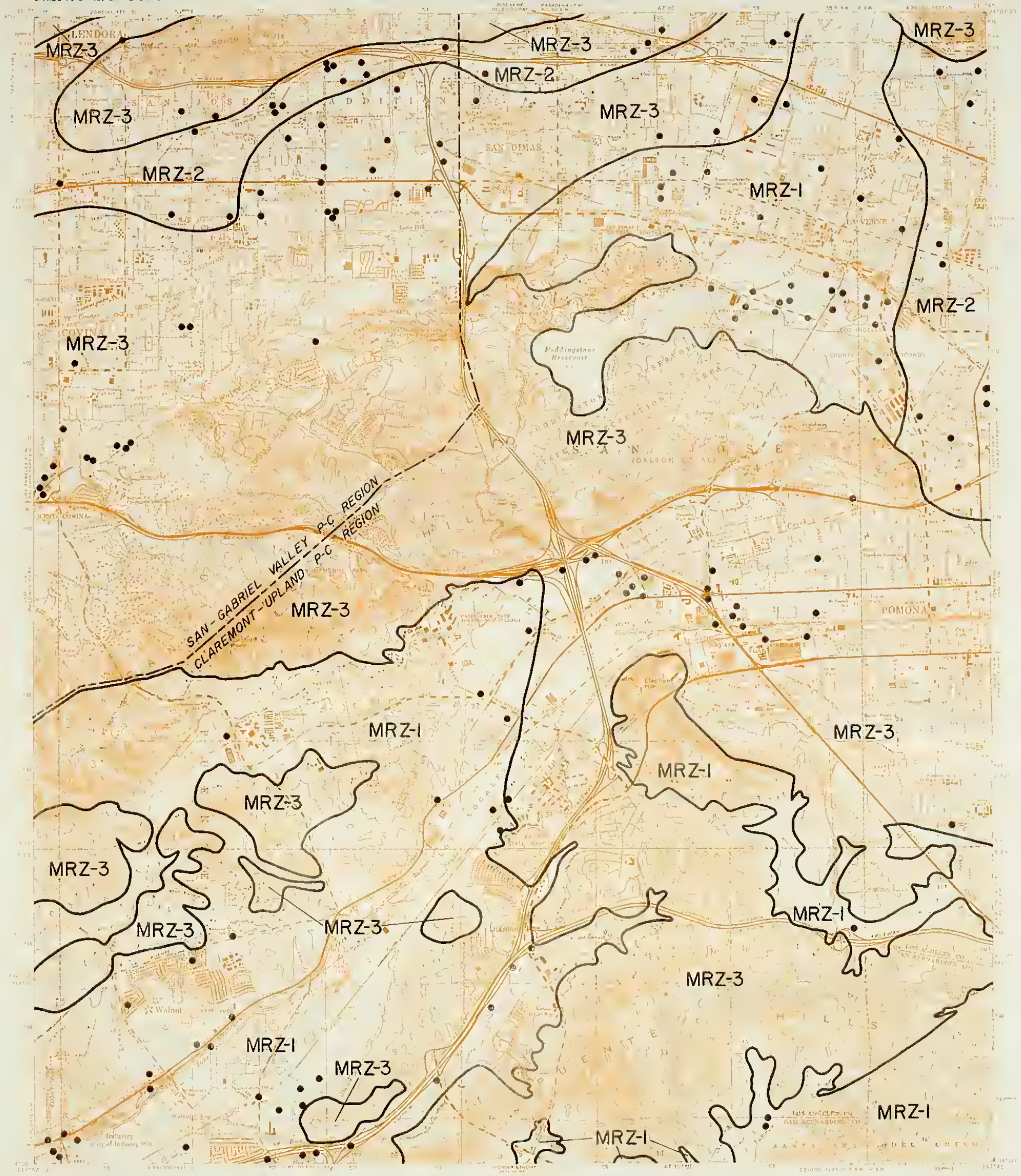
SAN DIMAS, CALIF.
SPECIAL REPORT 143 PLATE 6.7



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
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CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10 FOOT INTERVALS

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SAN DIMAS, CALIF.

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION. Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
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- MINERAL RESOURCE ZONE BOUNDARIES

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See text for additional explanation of MRZ Symbols.

By
Judy
Wiedenheft
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MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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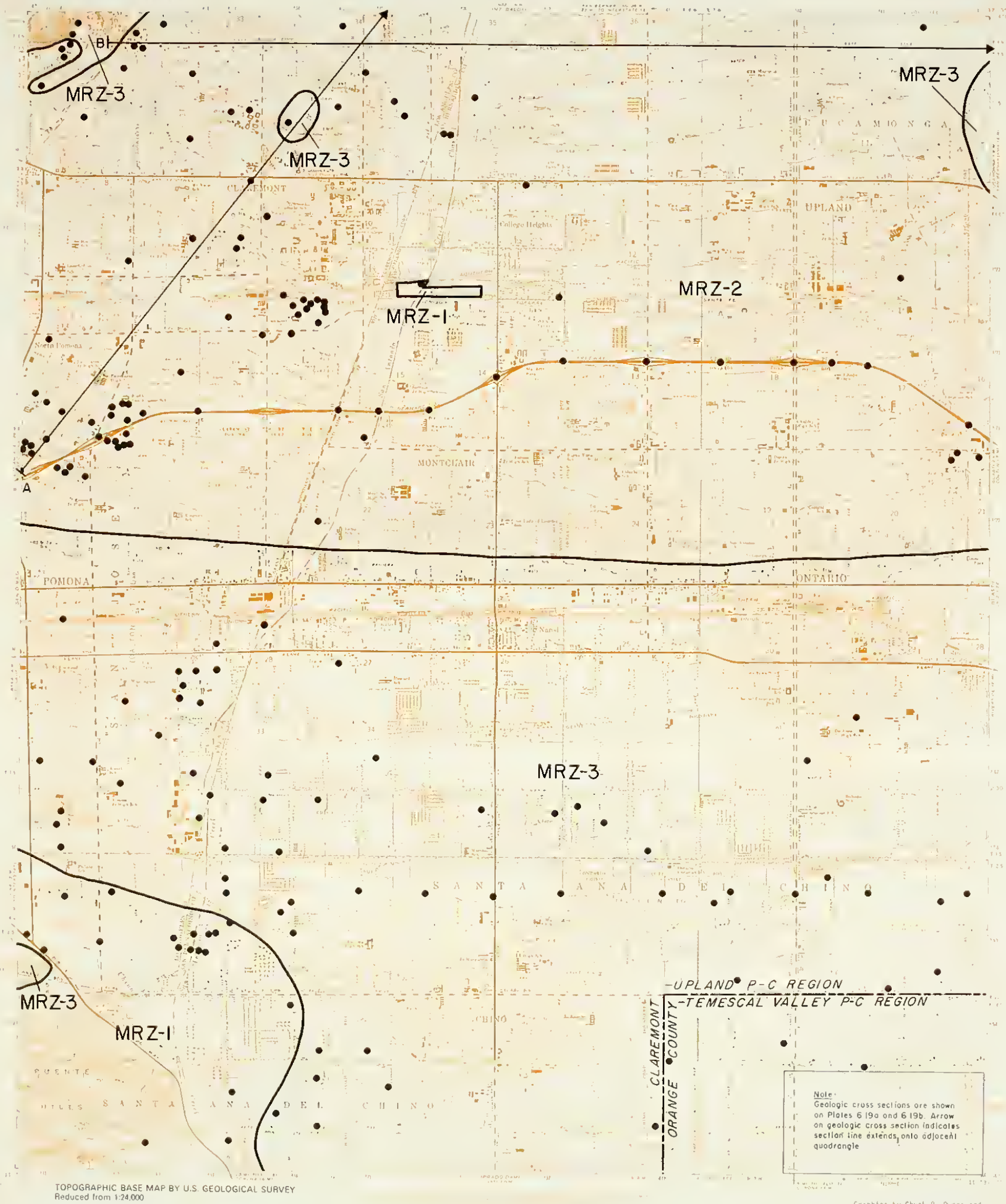
ONTARIO QUADRANGLE

SPECIAL REPORT 143 PLATE 6.8



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

Graphics by Chuck R. Owens and Dale M. Stickney

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

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See text for additional explanation of MRZ Symbols

By
Judy
Wiedenheft
Cole

ONTARIO, CALIF.

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

STATE GEOLOGIST

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QUASTI QUADRANGLE

SPECIAL REPORT 143 PLATE 6.9

MRZ-2
B
B'
MRZ-3
MRZ-3
MRZ-2
MRZ-3
MRZ-2
MRZ-3
CLAREMONT-UPLANO P-C REGION
SAN BERNAROINO P-C REGION
CLAREMONT-UPLANO P-C REGION
ORANGE COUNTY - TEMESCAL
SAN BERNARDINO P-C REGION
VALLEY P-C REGION

Note:
Geologic cross sections are shown on Plates 6.19a and 6.19b. Arrow on geologic cross section indicates section line extends onto adjacent quadrangle.

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

Graphics by Chuck R. Owens and Dale M. Stickney

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION. Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- PRODUCTION-CONSUMPTION REGION BOUNDARY (see text for discussion)
- MINERAL RESOURCE ZONE BOUNDARIES
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MRZ-2

See text for additional explanation of MRZ Symbols.

By
Judy
Wiedenheft
Cole

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

STATE GEOLOGIST

QUASTI, CALIF

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LA HABRA QUADRANGLE
SPECIAL REPORT 143 PLATE 6.10

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

Graphics by James D. Williams and Dale M. Stickney

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION. Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- PRODUCTION-CONSUMPTION REGION BOUNDARY (see text for discussion)
- MINERAL RESOURCE ZONE BOUNDARIES

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See text for additional explanation of MRZ Symbols.

By
Judy
Wiedenheft
Cole

LA HABRA, CALIF.

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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YORBA LINDA, CALIF.
SPECIAL REPORT 143 PLATE 6.11

MRZ-1
MRZ-3
MRZ-2
CLAREMONT-UPLAND P-C REGION
ORANGE COUNTY – TEMESCAL VALLEY P-C REGION
BREA
CAÑON DE SANTA ANA

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
  Bounderies estebllshed from dela supplied by the Office of Planning end Reseerch with modifications developed from information supplied by locel government and other sources. Hechures lie within erea undergoing ulbenization.
- PRODUCTION-CONSUMPTION REGION BOUNDARY
  (see text for discussion)
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See text for additional explenation of MRZ Symbols.

By
Judy
Wiedenheft
Cole

Graphics by James D. Williams and
Dale H. Stickney

YORBA LINDA, CALIF

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

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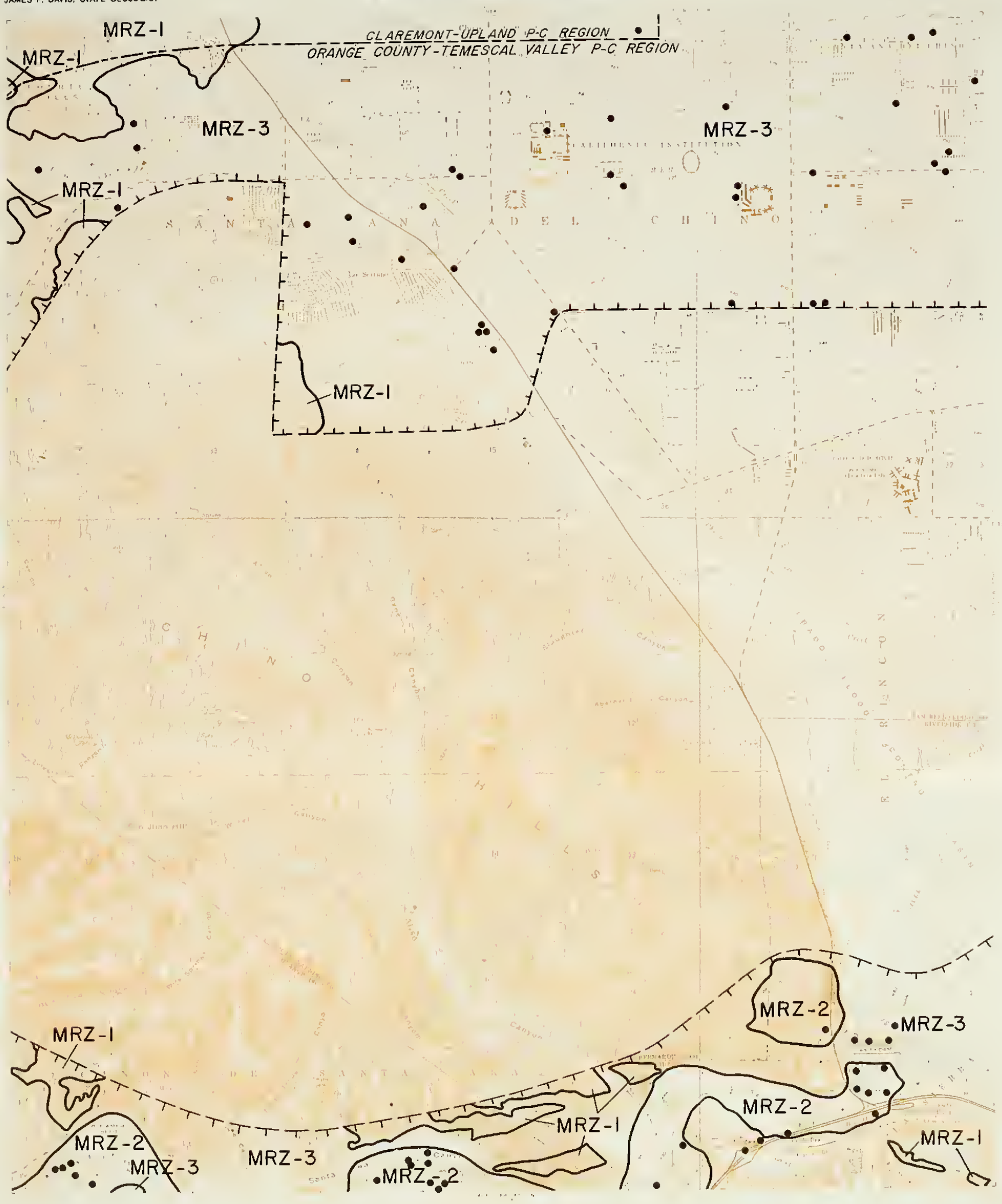
PRADO DAM QUADRANGLE

SPECIAL REPORT 143 PLATE 6.12



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

Graphics by James D. Williams and Dale M. Stickney

PRADO DAM, CALIF.

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION. Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- PRODUCTION-CONSUMPTION REGION BOUNDARY (see text for discussion)
- MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols

By
Judy
Wiedenheft
Cole

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

Claremont-Upland P-C Region

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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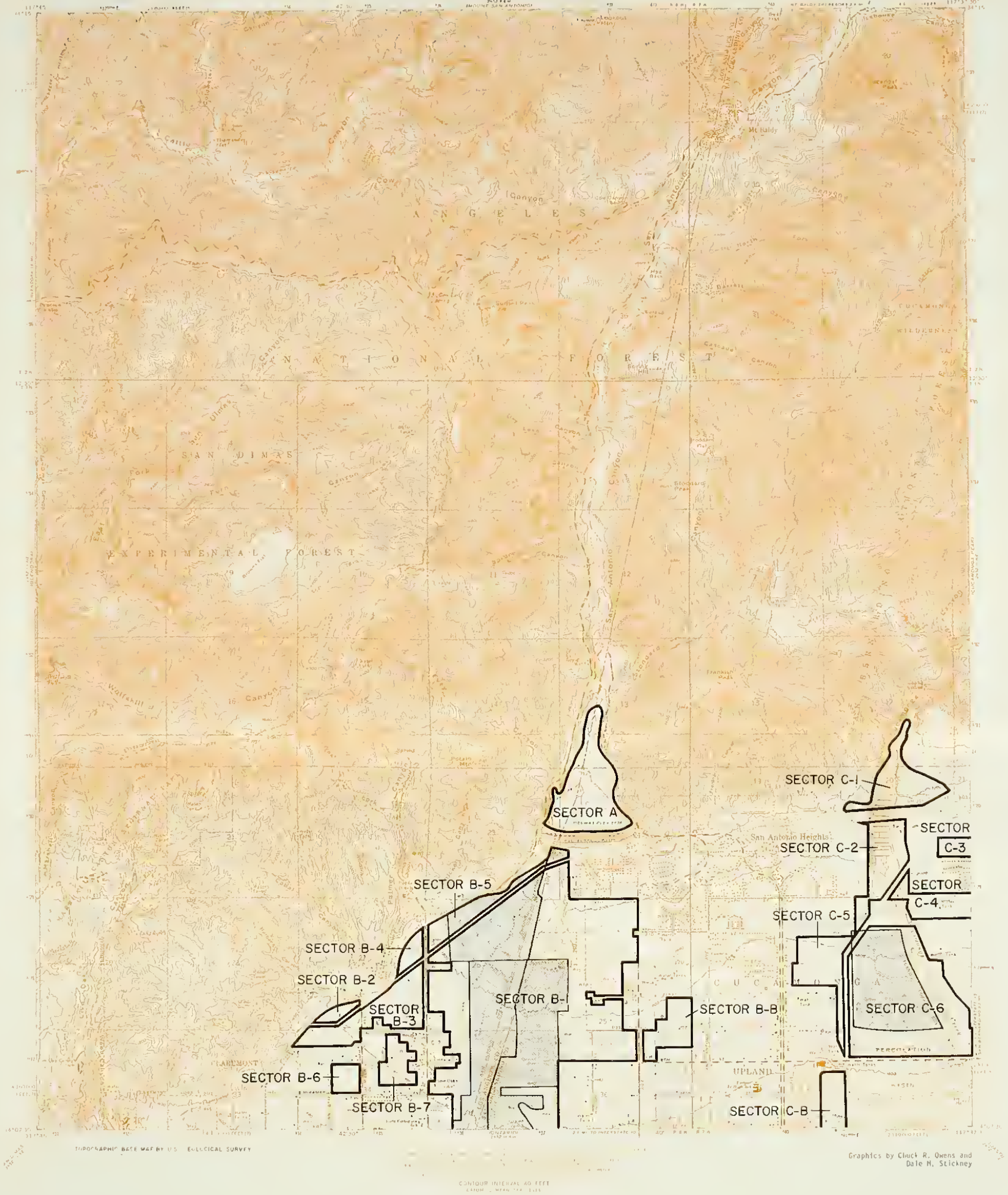
MT BALDY QUADRANGLE

SPECIAL REPORT 143 PLATE 6.13



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

CONTOUR INTERVAL 40 FEET

Graphics by Chuck R. Owens and Dale H. Stickney

MT. BALDY, CALIF.

EXPLANATION

Sector boundary

Properties owned or controlled by aggregate producers

N

Aggregate Resource Sectors

Claremont-Upland P-C Region

By
Judy Wiedenhefl Cole
1983

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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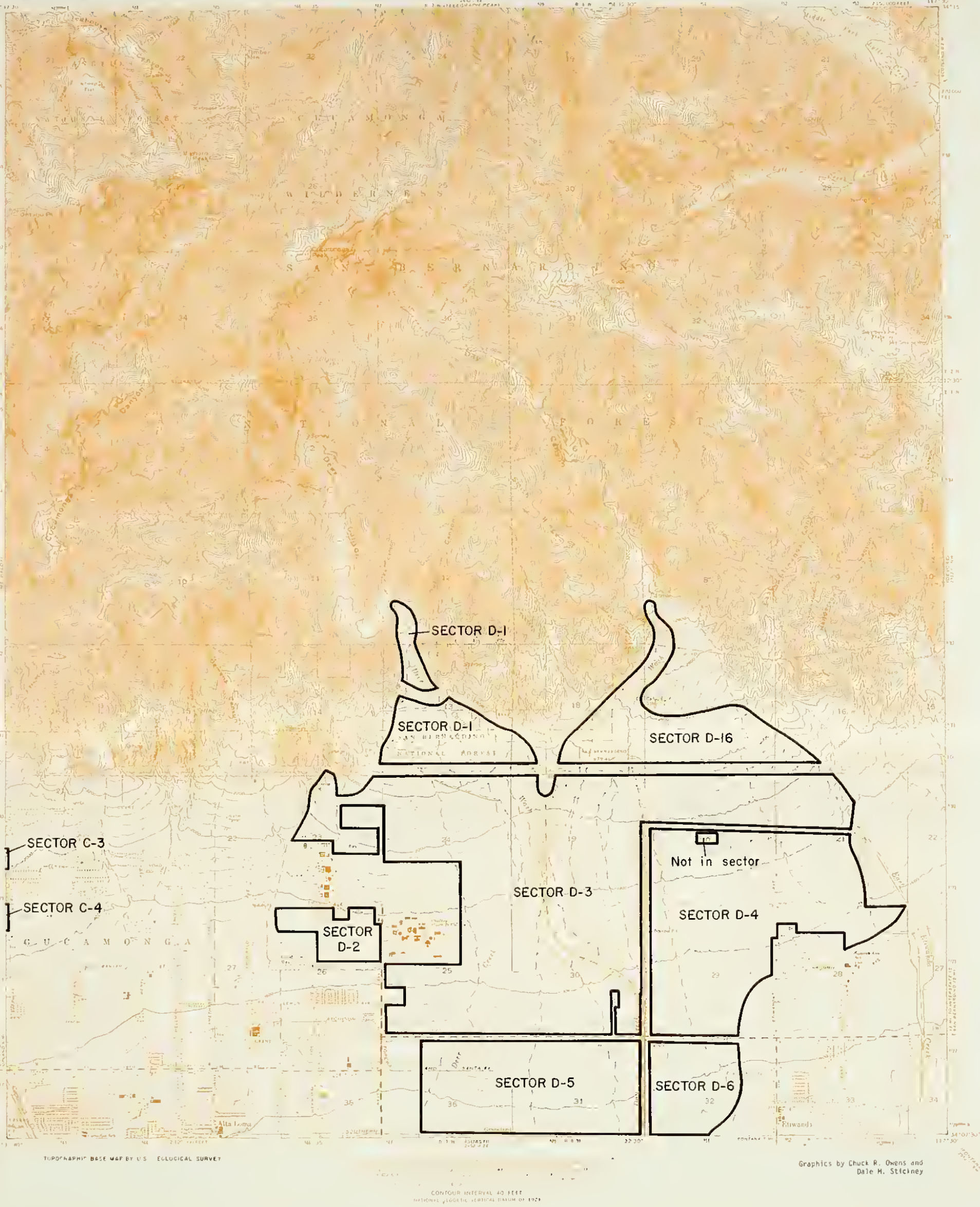
CUCAMONGA PEAK QUADRANGLE

SPECIAL REPORT 143 PLATE 6.14



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

Graphics by Chuck R. Owens and Dale H. Stickney

CONTOUR INTERVAL 40 FEET

CUCAMONGA PEAK, CALIF.

EXPLANATION

Sector boundory

Properties owned or controlled by oggregate producers

N

Aggregate Resource Sectors

Claremont-Upland P-C Region

By
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1983

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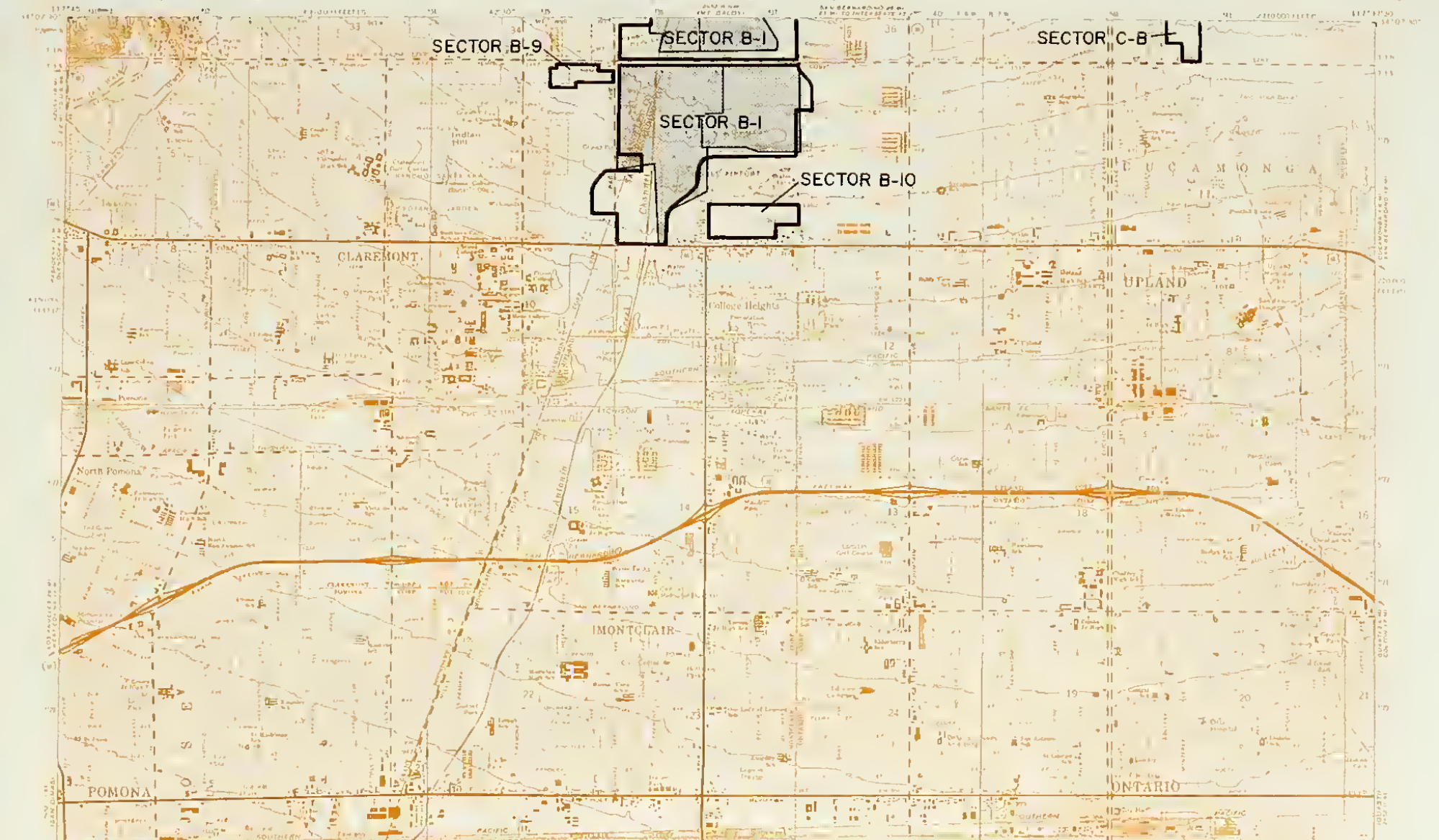
ONTARIO QUADRANGLE

SPECIAL REPORT 143 PLATE 6.15



ONTARIO, CALIF

EXPLANATION

Sector boundory

Properties owned or controlled by aggregate producers

N

Aggregate Resource Sectors

Claremont-Uplond P-C Region

By
Judy Wiedenheft Cole
1983

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QUASTI QUADRANGLE

SPECIAL REPORT 143 PLATE 6.16

SECTOR O-7

SECTOR O-8

SECTOR D-9

Not in sector

SECTOR D-10

SECTOR O-11

Not in sector

SECTOR O-12

SECTOR O-13

SECTOR O-14

SECTOR O-15

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

Graphics by Chuck R. Owens and Dale M. Stickney

QUASTI, CALIF

EXPLANATION

Sector boundary

Properties owned or controlled by aggregate producers

N

Aggregate Resource Sectors

Cloremont-Uplond P-C Region

By
Judy Wiedenheft Cole
1983

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GLENDORA QUADRANGLE
SPECIAL REPORT 143 PLATE 6.17

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

Graphics by Chuck R. Owens and Dale M. Stickney

CONTOUR INTERVAL 10 FEET

GLENDORA QUADRANGLE

EXPLANATION

Sector boundary

Properties owned or controlled by aggregate producers

N

Aggregate Resource Sectors

Claremont - Upland P-C Region

By
Judy Wiedenheft Cole
1983

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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SAN DIMAS, CALIF.
SPECIAL REPORT 143 PLATE 6.18

SECTOR E-1
SECTOR E-2
SECTOR E-5

GLENDORA
SAN JOSE HILLS
SAN DIMAS
LA VERNE
COVINA
POMONA
WEST COVINA
Puddingstone Reservoir
Walnut
Diamond Bar
Industry
SAN JOSE HILLS
PUENTE HILLS

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Graphics by Chuck R. Owens and Dale M. Stickney

SAN DIMAS, CALIF.

EXPLANATION

Sector boundary

Properties owned or controlled by aggregate producers

N

Aggregate Resource Sectors

Claremont-Upland P-C Region

By
Judy Wiedenheft Cole
1983

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

STATE GEOLOGIST

TN
94
C3
A33
no.143
pt.6

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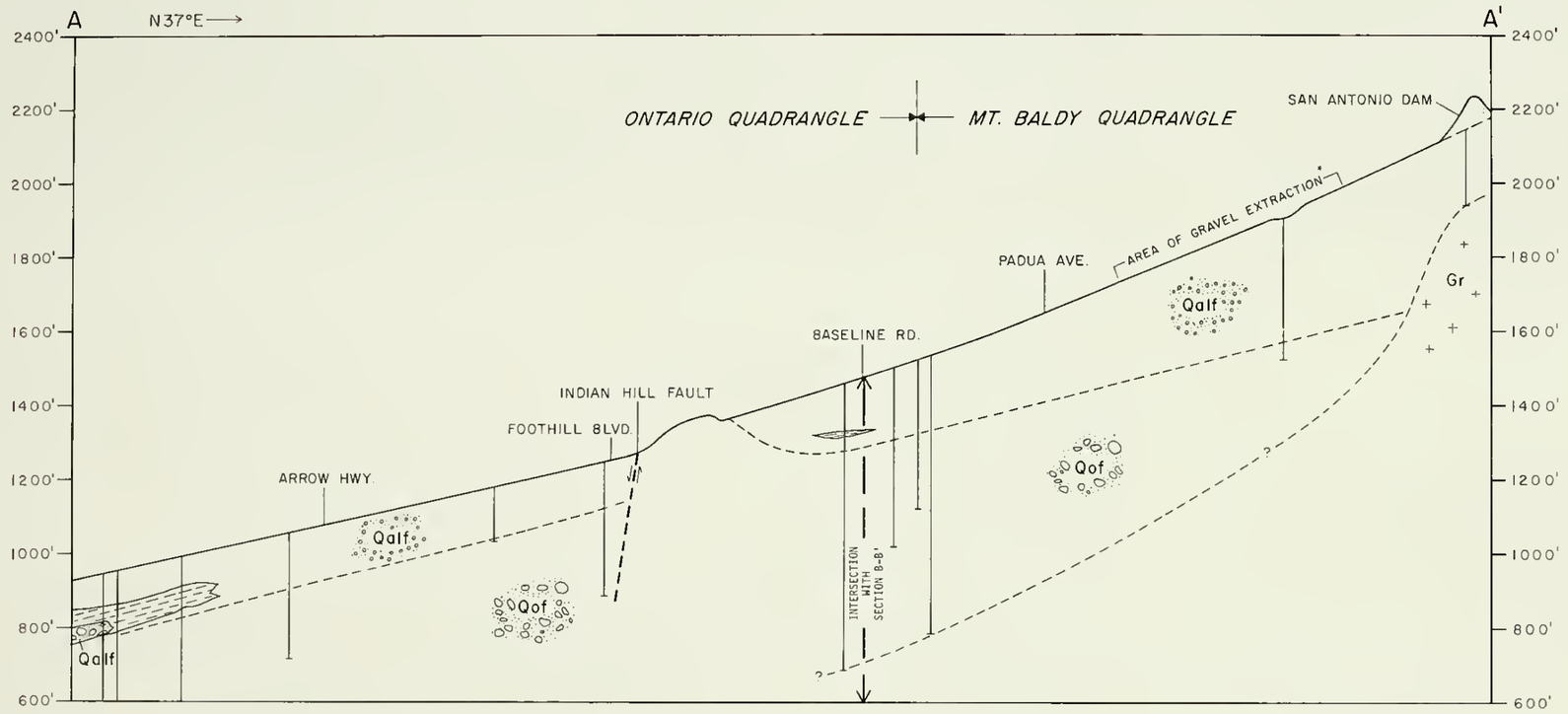
SPECIAL REPORT 143
PLATE 6.19a



MINERAL LAND CLASSIFICATION OF THE GREATER LOS ANGELES AREA
CLAREMONT-UPLAND PRODUCTION-CONSUMPTION REGION
GENERALIZED GEOLOGICAL SECTION OF THE SAN ANTONIO FAN

By J.W. Cole

1983

VERTICAL EXAGGERATION 10:1

SCALE 1:48,000

0' 2000' 4000'

400'
200'
0'

EXPLANATION

CENOZOIC — QUATERNARY — *PLEISTOCENE HOLOCENE*

Qalf — Holocene alluvial fan deposits: predominantly sand and gravel; clay lenses shown where observed in, or interpreted from, well log data.

Qof — Pleistocene alluvial fan deposits: alternating clay and gravel or clay gravel layers. Material is deeply weathered, thus clasts are not consistently durable. Often described in water well logs as red in color.

MESOZOIC — JURA-CRETACEOUS

Gr — Mesozoic crystalline rocks (intrusive and metamorphic): predominantly quartz diorite.

SYMBOLS

Contact: solid where well known, dashed where inferred, queried where conjectural.

Fault: dashed where questionable (arrows indicate relative movement).

Drill hole

NOTES:

1. Geology taken from: Cox and Morton (1978); Morton (1974); Rogers (1967); and unpublished water well log data, California Department of Water Resources and Los Angeles County Flood Control District.
2. Refer to plates 6.3, 6.8, and 6.9 for location of section lines.
*3. Topography as shown on 1967 U.S.G.S. quadrangles.

Graphics By C.R. Owens

TN
24
C3
A33
no. 143
pt. 6

DIVISION OF MINES AND GEOLOGY
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THE RESOURCES AGENCY—GORDON K. VAN VLECK, SECRETARY
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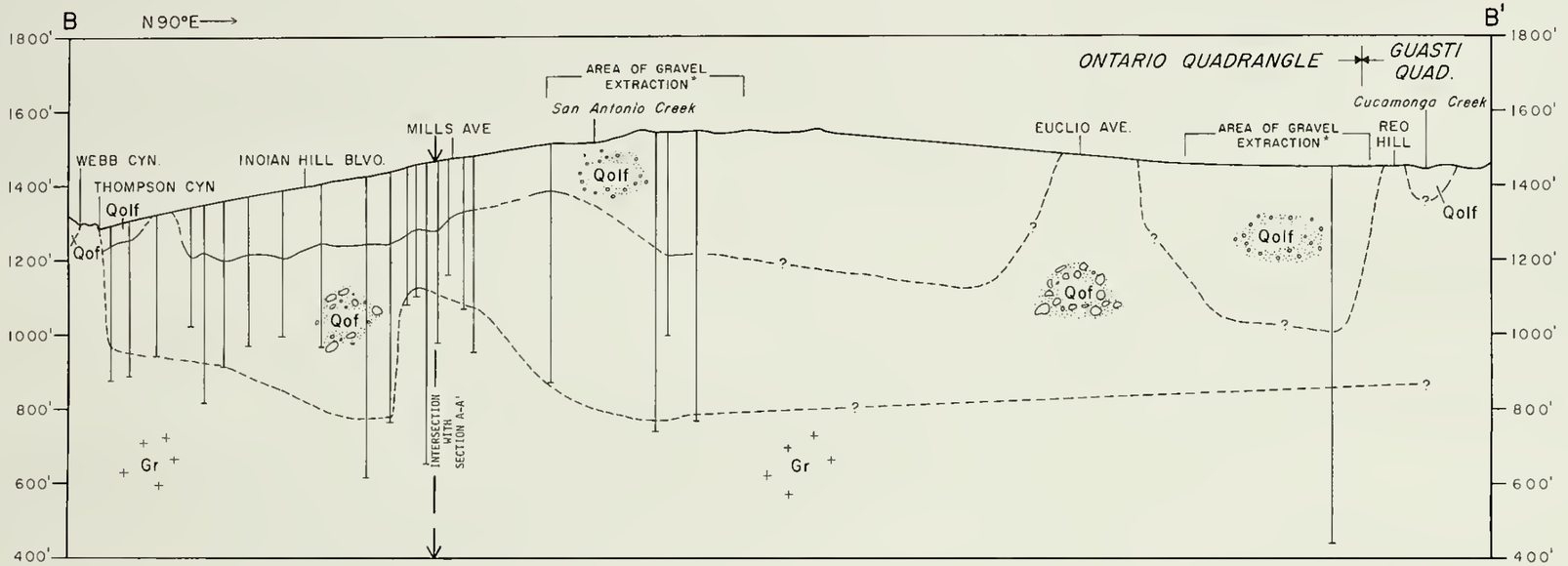
SPECIAL REPORT 143
PLATE 6.19b



MINERAL LAND CLASSIFICATION OF THE GREATER LOS ANGELES AREA

CLAREMONT-UPLAND PRODUCTION-CONSUMPTION REGION

GENERALIZED GEOLOGICAL SECTION OF SAN ANTONIO AND CUCAMONGA FANS

By J.W. Cole

1983

VERTICAL EXAGGERATION 10:1

SCALE 1:48,000

0' 2000' 4000'

400'
200'
0'

EXPLANATION

CENOZOIC
QUATERNARY
PLEISTOCENE HOLOCENE

Qolf — Holocene alluvial fan deposits: predominantly sand and gravel; clay lenses shown where observed in, or interpreted from, well log data.

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JURA-CRETACEOUS

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Drill hole

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*3. Topography as shown on 1967 U.S.G.S. quadrangles.

Graphics By C.R. Owens

PSL
TN
24
c3
A33
no. 143
pt. 6

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SPECIAL REPORT 143
PLATE 6.20

CLAREMONT-UPLAND P-C REGION

SAN GABRIEL P-C REGION

ORANGE COUNTY-TEMESCAL VALLEY P-C REGION

SAN BERNARDINO P-C REGION

NOT IN A P-C REGION

N

GENERALIZED MAP SHOWING RESOURCE AREAS IN THE CLAREMONT-UPLAND AND ADJACENT P-C REGIONS

MRZ-2; See Appendix

10 5 0 5 10 Statute Miles

10 5 0 5 10 Kilometers

Base map taken from U.S.Geological Survey at a scale of 1:250,000.

Graphics by James D. Williams